日本古生物学會
報告・紀事

Transactions and Proceedings
of the
Palaeontological Society of Japan

New Series No. 34

日 本 古 生 物 学 会

Palaeontological Society of Japan

June 15, 1959

CONTENTS

TRANSACTIONS

All Communications relating to this Journal should be addressed to the

PALAEONTOLOGICAL SOCIETY OF JAPAN

Geological Institute, Faculty of Science, University of Tokyo, Japan

Trans. Proc. Palaeont. Soc. Japan, N. S., No. 34, pp. 53-65, pl. 6, June 15, 1959

359. TAXODONTA AND ISODONTA FROM THE UPPER JURASSIC SAKAMOTO FORMATION IN CENTRAL KYUSHU, JAPAN*

MINORU TAMURA

Faculty of Education, Kumamoto University

上部ジュラ系坂本層産の Taxodonta 及び Isodonta: 熊本県南部に分布する上部ジュラ系坂本層より産する Taxodonta 6 種, Isodonta 16 種, 計 22 種 (うち 5 新種) を記載した。又 *Catella* (*Torinosucatella*) *kobayashii*, new subgen. and new sp. をもととして, *Catella* HEALEY の中に *Torinosucatella* 亜属を新設した。之等の二枚貝は既知外国種に同定されるものが殆んどないが, 全体として四国の佐川盆地の鳥の巣層群産のものに極めて類似している。 田 村 実

In the second part of this study the Taxodonta and Isodonta are described. The horizons and localities of the fossils have already been listed in the previous paper (TAMURA, 1959). T. KIMURA has described many pelecypods of these groups, especially Pectinaceae, from the Upper Jurassic Torinosu group in Sakawa basin (KIMURA, 1951 & 1956). Here *Catella* HEALEY (1908) is promoted to the generic rank and *Torinosucatella*, subgen. nov. is erected on *Catella* (*Torinosucatella*) *kobayashii*, new species. Remarks are given on *Somapecten* which is very akin to *Entolium* and has a peculiar strong angular conical tooth in the right valve and a corresponding socket in the other valve. The species here described are as follows:

Parallelodon inflatus TAMURA, new species
Grammatodon takiensis KIMURA
Catella (*Torinosucatella*) *kobayashii* TAMURA, new subgenus and new species
Nuculana (*Praesaccella*) *erinoensis* KIMURA
Nuculana (*Praesaccella*) *yatsushiroensis* TAMURA, new species
Nuculana (*Dacryomya*) *stenodolichos* KIMURA
Chlamys (*Chlamys*) *iboibo* KURATA and KIMURA
Chlamys (*Chlamys*) sp.
Chlamys (*Radulopecten*) *ogawensis* KIMURA
Chlamys (*Radulopecten*) *nagatakensis* KURATA and KIMURA
"*Aequipecten*" *vulgaris* KIMURA
"*Aequipecten*" *kotsubu* (KIMURA)
Camptonectes sp. aff. *browni* COX
Camptonectes ? sp.
Eopecten sp.
Variamussium habunokawense (KIMURA)
Entolium yatsujiense KURATA and KIMURA
Entolium kimurai TAMURA, new species
Somapecten kamimanensis KIMURA
Lima (*Plagiostoma*) sp.
Lima (*Ctenoides*) *tosana* KIMURA
Limatula reticulata TAMURA, new species

The writer records his sincere thanks to Prof. T. KOBAYASHI of the University of Tokyo for his kind guidance and supervision of the manuscript. Thanks are also due to Assist. Prof. T. KIMURA and Mr. I. HAYAMI of the same University for assistances in laboratory works.

Family Parallelodontidae

Genus *Parallelodon* MEEK and WORTHEN, 1866

Parallelodon inflatus TAMURA, new species

Plate 6 Figures. 9, 10.

* Received Aug. 30, 1958; read Sept. 27, 1958.

Description:—Shell medium sized for genus, elongated and oblong in outline, with length nearly equal to twice the height, strongly inflated; umbo at about 1/3 or a little less from the anterior end, improminent, prosogyrate and incurved; sinus invisible on ventral side; carina-like angulation passing from umbo to postero-ventral corner; two long posterior teeth nearly parallel to ventral margin; hinge of *Parallelodon;* 4 posterior and 6 anterior teeth all short in left valve; surface probably smooth except for growth-lines.

This species is based on very inflated internal moulds of right valves which have no ventral sulcation.

Measurements:—

	L	H
holotype	43 mm	19 mm
	37 mm	20 mm

Occurrence:—Locs. 4, 6.

Family Cucullaeidae FINLAY and MARWICK, 1937, emend. NICOL, 1954

Genus *Grammatodon* MEEK and HAYDEN, 1860

Grammatodon takiensis KIMURA

Plate 6, Figures 1, 2.

1956. *Grammatodon takiensis*, KIMURA, p. 85, pl. 1, fig. 6.

Shell small to medium, strongly inflated, subrectangular in outline, length to height about 3:2; posterior margin longer than anterior; umbo at a third or more of the length from anterior, a little prosogyrate and incurved; fairly distinct carina running from umbo to postero-ventral margin, but an anterior one weak; surface covered by fine concentric lamellae but obscure on lateral sides; posterior side depressed and ornamented with about 13 radial ribs; anterior area with about 6 radial ribs; very fine radial ribs present in median part but generally obscure; hinge typical of *Grammatodon.*

Occurrence:—Many specimens of internal and external moulds of both valves occur at Locs. 1, 2, 4, 5, 6, 7, 9, 11, 12, some being deformed.

Genus *Catella* HEALEY, 1908

Type-species:—*Grammatodon* (*Catella*) *laticlava* HEALEY.

Generic diagnosis:—Shell equivalve, inequilateral, inflated, trapeziform in outline and a little produced posterior; umbo slightly prosogyrate, situating a little anterior to center; surface ornamented with concentric lamellae or radial ribs; a strong internal ridge passing from umbo towards ventral margin nearly perpendicular to hinge margin; the corresponding external constriction present; hinge structure of *Grammatodon* type.

Remarks:—Subgenus *Catella* was erected by HEALEY (1908) on *Grammatodon* (*Catella*) *laticlava* HEALEY from the Rhaetic Napeng beds of Burma, which has a strong internal rigde and a corresponding fairly wide constriction in surface passing from the umbo toward the ventral margin. She included this subgenus in *Grammatodon* MEEK and HAYDEN, although the concentric lines in *laticlava* are almost invisible in *Grammatodon.*

Several specimens with an external constriction and an internal ridge were collected from the Upper Jurassic Sakamoto formation. In hinge structure it agrees with *Grammatodon* inclusive of *Catella.* In these specimens, however, radial ribs are closely spaced and some

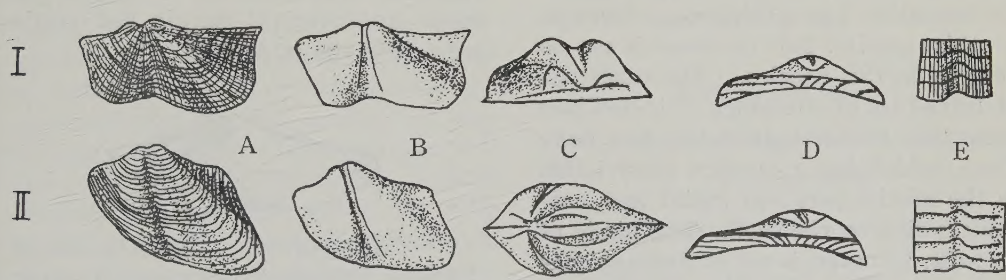
concentric wrinkles weaker than the radial ribs and obscure in some forms. G. Troedsson (1951) described *Grammatodon* (*Catella*) *sinuatus* and *G.* (*C.*) *subrhomboidalis* from the Katslosa bed of Höganäs Series of Sweden whose age is uppermost Sinemurian or its transition to Pliensbachian. The former is ornamented with radial ribs and concentric wrinkles as the Sakamoto form. On the other hand, the latter has the same external ornaments as *G.* (*C.*) *laticlava* Healey. The internal ridge and the external constriction of *Catella* are evidently different from the ventral sinus of *Parallelodon* or *Barbatia* in which the sinus forms a byssal gape.

Emphasizing primarily the internal ridge and the corresponding external constriction and secondarily the external ornaments, the writer promotes *Catella* Healey to the generic rank. *Torinosucatella* is erected as its subgenus which is represented by *C.* (*T.*) *kobayashii* from Sakamoto formation and includes *G.* (*C.*) *sinuatus* Troedsson (1951).

Subgenus *Torinosucatella* Tamura, new subgenus.

Type-species:—Catella (*Torinosucatella*) *kobayashii* Tamura, new species.

Diagnosis:—Catella with radial ribs and concentric wrinkles on surface; posterior end protruded and generally auriculate; hinge of *Grammatodon* type.



Text-Figure 1. *Catella* (*Catella*) *laticlava* Healey (II) and *Catella* (*Torinosucatella*) *kobayashii* Tamura, new sp. (I): surface (A), internal mould (B), umbonal part (C), hinge area (D), enlarged constriction (E).

Catella (*Torinosucatella*) *kobayashii* Tamura, new species

Plate 6, Figures 11-16.

Description:—Shell small, inequilateral, well inflated, trapeziform in outline; umbo at about 1/3 across from anterior end, slightly prosogyrate and incurved; hinge line longest, straight and auriculate posteriorly; posterior margin a little sulcated; postero-ventral corner produced; median constriction deep, broadened and becomes shallow near venter; anterior area smaller than posterior; constriction a little strengthened internally; ventral margin fairly deeply sulcated at the median part; carina-like ridge round-topped, passing from umbo to postero-ventral margin; post-carinal area depressed; surface ornamented with dense radial ribs and several concentric wrinkles on ventral side; hinge of *Grammatodon* type.

Measurements:—

	L	H
holotype	12 mm	6 mm
	12	6
	10	4

Comparison:—The ventral sinus is deep but the gape, if present, is narrow. The posterior auricle and long hinge margin are also distinct specific characters. Externally, this is similar to alate *Parallelodon* as typified by *P. rugosum* (ARKELL, 1930–1). The median sinuation is absent in the alate group.

G. (*C.*) *sinuatus* TROEDSSON somewhat resembles this in ornaments but has coarse ribs. The posterior dorsal end of *sinuatus* is probably not so distinctly alate as in *kobayashii*. *Macrodon* sp. (FIEBELKORN, M., 1893) in north German boulder derived from the Upper Jurassic formation has a fairly deep sinus as in this species but its sinus is not so deep as in this species. The sandstone of Infra-Lias of Hettange, Vic-de-Chassenay and Halberstadt yields *Arca pulla* TERQ. which has a distinct constriction in the middle part and radial and concentric ribs on the shell. The hinge of *A. pulla*, however, is not of *Grammatodon* type.

Occurence:—Locs. 6, 11.

Family Nuculanidae

Genus *Nuculana* LINK, 1807

Subgenus *Praesaccella* COX, 1940

Nuculana (*Praesaccella*) *erinoensis* KIMURA

Plate 6, Figures 3–6.

1956. *Nuculana* (*Rollieria?*) *erinoensis*, KIMURA, p. 84, pl. 1, figs. 3, 4.

Description:—Shell medium sized for genus, depressed, subequilateral, elongately ovate in outline, with the length about twice the height; umbo nearly orthogyrate, situated a little anteriorly; antero-dorsal margin a little shorter than posterior, both margins nearly straight and forming 140°–150° apical angle at umbo; anterior extremity rounded; posterior extremity a little rostrate, situated above the middle of the height; ventral margin evenly rounded; surface ornamented with fine numerous concentric growth-lines; no disinct carina on rostration; hinge teeth discontinuous below umbo and very minute below umbo; chondrophore invisible; anterior series of chevron-shaped teeth nearly straight, about 30 in number; posterior ones a little arcuate and 50 in number; two short irregularly disposed ridges running from umbo towards anteroventral margin and attaining nearly the midheight.

Text-Figure 2. Internal mould of *Nuculana* (*Praesaccella*) *erinoensis* (KIMURA) showing internal ridges.

Measurements:—

	L	H
holotype	24 mm	14 mm
	37	19
	21	13
	?	15
	21	9

Observation and Comparison:—Several internal and external moulds of both valves from the Sakamoto formation are larger than in the Torinosu group in Sakawa basin. Partly due to deformation the shells vary in outline. Internal ridges of this species are distinct. The posterior gaping is seen in a specimen (Fig. 3). *Rollieria* has ovate in shape in

general, while this form is elongate and rostrate posteriorly. Therefore it is better located in *Praesaccella* than in *Rollieria.*

Palaeoneilo belaënsis Cox (1940, pl. 1, fig. 1) from the Patcham bed in Cutch is allied to a specimen (Fig. 5) of the species but the posterior and anterior series of denticles are continuous below the umbo.

Occurrence:—Locs. 1, 4, 5, 6, 9, 11, 12.

Nuculana (*Praesaccella*) *yatsushiroensis* TAMURA, new species

Plate 6, Figures 7, 8.

Description:—Shell small for genus, fairly convex, subequilateral to inequilateral, longer than high; umbo orthogyrate and almost medially situated or a little anterior to center; antero- and postero-dorsal margins slightly arcuate or nearly straight; ventral margin well rounded; posterior extremity a little rostrate and situated above the mid-height of shell, depressed; carina running from umbo to posterior extremity bounding narrow depressed escutcheon; surface ornamented with fine numerous concentric lines; hinge-teeth probably discontinuous between posterior (about 15 in number) and anterior sets (about 15) below umbo, posterior one smaller in size.

Measurements:—

	L	H
holotype	6.5 mm	4.0 mm
	6.0	4.0
	5.5	3.5
	5.5	4.5
	6.0	4.5
	8.0	4.5

Comparison:—There are several internal moulds of both valves, some of which are deformed. They are small in size. This species is closely allied to *Nuculana* (*Praesac.*) *erinoensis* KIMURA which occur together. The smaller size, more inflated form, smaller number of chevron-shaped teeth and no irregular ridges on internal surface in this species are its distinction from *erinoensis.*

Occurrence:—Locs. 1, 4, 11, 12.

Subgenus *Dacryomya* AGASSIZ, 1840

Nuculana (*Dacryomya*) *stenodolichos* KIMURA

Plate 6, Figures 17-19.

1956. *Nuculana* (*Dacryomya*) *stenodolichos,* KIMURA, p. 83, pl. 1, fig. 1.

Occurrence:—Several specimens of internal and external moulds of both valves from Locs. 4, 11.

Family Pectinidae

Genus *Chlamys* BOLTON MS, RÖDING, 1798

Subgenus *Chlamys* s. str.

Chlamys (*Chlamys*) *iboibo* KURATA and KIMURA

Plate 6, Figures 35, 36.

1951. *Chlamys iboibo,* KIMURA, p. 339, pl. 1, figs. 2-4.

One external and internal moulds of a left valve and two broken internal moulds of right valves are at hand. Radial 10 ribs on right valve are bifurcating near umbo and their interspaces on ventral side equally spaced. Some Sakamoto specimens are about twice as large as the Sakawa form.

Occurrence:—Locs. 8, 11.

Chlamys (*Chlamys*) sp.

Plate 6, Figure 38.

Shell very small for genus (L: 6 mm, H: 9 mm). Right valve subequilateral, strongly depressed, elongately ovate; hinge margin straight; postero- and antero-dorsal margins nearly straight and steeply sloping and forming about 70° angle; ventral margin rounded but a little oblique to backward: ears moderate in size; anterior a little larger than the posterior, anterior and posterior extremities acute- and obtuse-angled respectively; sulcation below anterior ear indistinct; surface sculptured by 8 or 10 radial ribs which are narrower than their interspaces and crossed by fine concentric striae.

The right valve of *Chlamys* (*Ch.*) *iboibo* is similar to this specimen, but the small number of radial ribs distinguishes this from that species.

Occurrence—Loc. 6.

Subgenus *Radulopecten* ROLLIER, 1911

Chlamys (*Radulopecten*) *nagatakensis* KURATA and KIMURA

Plate 6, Figures 31, 32.

1951. *Chlamys nagatakensis*, KIMURA, p. 338, pl. 1, fig. 1.

Description:—Left valve depressed, slightly inequilateral, orbicular, longer than high; hinge margin about 1/2.5 of the length, straight; ears unequal, anterior one about twice or more than posterior; two diverging radial riblets on anterior ear; extremity of anterior ear nearly 90° and posterior one obtuse-angled; sulcation below anterior ear indistinct; dorsal margins nearly straight, forming about 100° apical angle; ventral semi-circular; surface sculptured by 8 radial ribs among which middle ones are wider than laterals; their interspaces nearly as wide as ribs; very fine radial and concentric ribs on all surface.

Comparison:—This species closely resembles *Chlamys* (*Radulopecten*) *inequicostatus* (PHILLIPS) from Osmington Oolite from Yorks but the presence of distinct radial riblets on chief ribs of the right valve distinguishes this from that species. Japanese *Gloripallium* from the Miocene (*G. izurensis* MASUDA, 1958 etc), is very alike this species. Therefore Jurassic *Radulopecten* may be ancestral to *Gloripallium*.

Occurrence:—Loc. 11.

Chlamys (*Radulopecten*) *ogawensis* (KIMURA)

Plate 6, Figure 37.

1951. *Aequipecten ogawensis*, KIMURA, p. 343, pl. 1, fig. 7.

KIMURA compared this species to *Chlamys* (*Aequipecten*) *fibrosa* (SOW.) by ARKELL (1931). A group containing *fibrosa* is now included in *Radulopecten* (COX, 1952).

Occurrence:—Two internal moulds of both valves from Loc. 6.

Genus *Aequipecten* FISCHER

"*Aequipecten*" *vulgaris* KIMURA

Plate 6, Figures 40, 41.

1951. *Aequipecten vulgaris*, KIMURA, p. 342, pl. 1, figs. 5, 6.

Radial ribs are about 13 in the Sakamoto form and their interspaces sculptured by about 4 fine riblets.

Occurrence:—Several specimens from Locs. 3, 4, 11.

"*Aequipecten*" *kotsubu* (KIMURA)

Plate 6, Figures 33, 34.

1951. *Neithea kotsubu*, KIMURA, p. 343, pl. 1, figs. 8, 9.

Description:—Left valve small, fairly convex, inequilateral, a little longer than high; hinge margin straight; anterior ear larger than posterior one; anterior extremity acute-angled and posterior one obtuse-angled; byssal sinus below anterior ear indistinct; two radial riblets on anterior ear divergent from umbo; anterior dorsal margin straight, longer than a little acute posterior one; beak a little projected beyond hinge margin; apical angle about 90°; ventral margin rounded and a little produced anteriorly; surface covered by flat-topped about 22 radial ribs, their interspaces wider than ribs.

Comparison:—The Sakamoto specimens are more inequilateral than Sakawa form but it is evident that these specimens are allied to *kotsubu*. These specimens from the Sakamoto area are included in "*Aequipecten*" because of biconvexity of the valves.

Occurrence:—Locs. 3, 4, 11.

Genus *Camptonectes* Meek, 1864

Camptonectes sp. aff. *browni* Cox

Plate 6, Figure 42.

aff. 1935. *Camptonectes browni*, Cox, p. 177, pl. 18, figs. 13a, b.

Left valve (34 mm high and 30 mm long) subequilateral, fairly inflated, nearly orbicular; umbo prosogyrate, a little projected beyond short hinge margin; ears neither large nor prominent; anterior ear inflated and gaping laterally, not delimited from the shell body; surface covered by radiating threads, coarser than the *Camptonectes* ornament, and by obsolete concentric ribs at irregular intervals.

The specimen closely resembles *Camptonectes browni* Cox (1935) from the Callovian of Somaliland in its prosogyrous umbo and coarse radiating threads. The sole difference is the lateral gaping of the ear of this specimen.

Occurrence:—Loc. 6.

Camptonectes ? sp.

Plate 6, Figure 39.

An external mould of a left valve slightly broken in hinge part, very small for genus, orbicular in outline, nearly flat; posterior and anterior lateral margins nearly straight, rounded, a little obliquely elongated backward; hinge not clear, dorsal margin straight; beak not reaching dorsal margin; surface covered by 9 erect concentric laminae at regular intervals which are obsolete near umbo.

The regular concentric laminae of the specimen somewhat resemble the ornament conspicuous of *Camptonectes annulatus* group but radial threads on surface are invisible in this specimen. This sole specimen is very small (4 mm high, 3 mm long) and its specific characters are imperfectly known.

Occurrence:—Loc. 8.

Genus *Eopecten* Douvillé, 1897

Eopecten sp. new

Plate 6, Figure 49.

Left valve small (H: 13mm, L: 14mm), inequilateral, orbicular, moderately convex and elevated near umbo; dorsal margins nearly straight, a little longer in anterior than the other; ventral a little produced anteriorly and orbicular; primary riblets fine, 20 or more; secondary finer threads intercalated.

Ears are not clearly defined from the shell body. Surface ornament is characteristic of *Eopecten*. *Velopecten rollei* Stoll. (Pčelincev, 1937) from Pliensba-

chian of South Ossetia of U. S. S. R. resembles this specimen but concentric plication is weaker or less in the latter.

Occurrence:—Only an internal mould of a left valve from Loc. 11.

Family Amusiidae

Genus *Variamussium* SACCO, 1897

Variamussium habunokawense (KIMURA)

Plate 6, Figures 20-22.

1951. *Propeamussium habunokawense*, KIMURA, p. 344, pl. 1, figs. 14, 15.

Description:—Shell small, subequilateral, depressed, slightly higher than long. Right valve depressed but more convex than left; hinge margin fairly long, straight; anterior one twice or more than posterior; anterior and posterior lateral margins a little concave, forming about 100° apical angle; ventral semi-circular; ears fairly large, depressed and distinctly marked from body; anterior ear large; byssal sinus below anterior ear fairly deep; surface sculptured by numerous fine regular concentric lines; about 9 elevated ribs on internal surface a few of which are restricted to ventral side; these internal ribs do not attain to ventral margin. Left valve similar to right valve but has about 20 or more radial ribs. In each interspace 1 or 2 finer ribs are inserted and intersected by numerous regular concentric lines; these radial ribs impressed feebly on internal surface.

Comparison:—This species was grouped in *Propeamussium* by KIMURA, as the radial ribs on the left valve are not of *Variamussium*. But the internal feeble riblets (KIMURA, 1951, pl. 1, fig. 15) suggest the presence of radial ornaments on the surface of the left valve. An imperfect external mould (Fig. 21) from the Sakamoto area shows distinct radial ribs. A byssal gape below the anterior ear is fairly deep. Therefore it is evident that this species belongs to *Variamussium* SACCO instead of *Propeamussium* GREGORIO (PHILIPPI, 1900).

Occurrence:—Locs. 10, 12.

Genus *Entolium* F. B. MEEK, 1865

Entolium yatsujiense KURATA and KIMURA

Plate 6, Figure 30.

1951. *Entolium yatsujiense*, KIMURA, p. 345, pl. 1, figs. 18a, b.

This is involved probably in the group of *Entolium cingulatum* GOLDF. (STAESCHE, 1926) by the presence of a pair of distinct internal ridges close to the auricular margins. The shell of the Sakamoto form is variable in size (4mm to 10 mm in height).

Occurrence:—Locs. 6, 7, 9, 11, 12, all in the western half of the area.

Entolium kimurai TAMURA, new species

Plate 6, Figures 23-29.

Description:—Shell medium to small for genus, equivalve exclusive of hinge area, equilateral, depressed, elongately ovate to orbicular in outline and higher than long in general; dorsal margin short and straight in left valve but rises above hinge margin in right valve; ears small, equal and their extremities roundedly obtuse-angled and depressed; auricular margins short, slightly arcuate or nearly straight and forming nearly 90° apical angle; ventral margin ovate; surface smooth; internally, auricular crura short but distinct; internal ridges obscure near auricular margins; wing-like elevation near umbo present in

each ear.

Measurments:—

	L	H	Apical angle
holotype	14 mm	18 mm	90°
	18	19	100
	12	14	100
	14	13	110
	11	16	90
	9	12	80

Observation:—Many specimens in hand are deformed in some degrees but their morphological variance can not be denied. In some specimens (Figs. 24, 26, 27, 28) the apical angle is 100° or more and height nearly equal to length. These specimens are inseparable from the typical form. Measurements and Figs. 23–29 show morphological variance of this species.

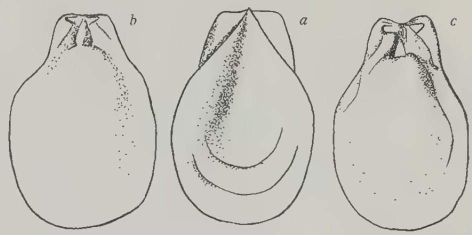
Comparison:—This species somewhat resembles *E. japonicum* KUR. and KIM. from the Sakawa basin. The latter, however, has a smaller apical angle (about 70°), its anterior ear is larger than the posterior and the dorsal margin of *japonicum* does not rise above the hinge margin. *Entolium demissum* PHILL. (STAESCHE, 1926; ARKELL, 1929) and *E. disciformis* SCHUEB. (DECHASEAUX, 1936) are closely allied to some forms of this species (Figs. 26–28). But fine growth-lines are destitute in this species and the shell is much smaller and generally not so circular as in these species.

Occurrence:—Most abundant and widely distributed in Sakamoto area. Locs. 2, 4, 5, 6, 7, 9, 11, 12.

Genus *Somapecten* KIMURA, 1951

Type-species: Somapecten kamimanensis KIMURA.

Diagnosis:—Shell equivalve exclusive of hinge area, equilateral, depressed but biconvex, elongately ovate and fan shaped, higher than long; ears equal and fairly large for the family, their corners rounded and obtuse-angled; dorsal margins in right valve rise above the straight hinge margin; surface smooth; internally auricular crura present; a paired triangular wing-like elevation below hinge margin; strong angular conical tooth found between paired pteriform elevations in right valve and a corresponding socket in left valve; lower surface of the tooth grooved.



Text-Figure 3. *Somapecten kamimanensis* KIMURA: exterior of left valve (a) interior of left valve (b), interior of right valve (c).

Remarks:—Jurassic *Entolium* and Late Palaeozoic *Pernopecten* (NEWELL, 1937) are the group having smooth surface and no ribs internally in the Amusiidae, though the two diverging distinct internal ridges near auricular margins are present in the group of *Entolium cingulatum* (GOLDF.) and the latter may be ancestral to the former. *Somapecten* is very akin to *Entolium* by its orbicular, compressed, subequivalved equilateral shell and smooth surface, except for the peculiar tooth and socket. Dorsal margins of the right valve in *Entolium* and *Somapecten* rise above the hinge margin, though it can be seen in the left of *Pernopecten* (anterior and posterior direction are based on weak adductor scar in *Somapecten*). Two divergent auricular crura and paired wing-like elevations below the hinge margin are also common characters between both genera. Whether it belongs to the

Amusiidae or not is a problem because its cardinal tooth in right valve and its socket in left have never been described in the Amusiidae. KIMURA compared this genus to *Entolium* and referred it to the Pectinidae. Here the writer places it in the Amusiidae owing to its resemblance to *Entolium* except for the tooth and socket.

Somapecten kamimanensis KIMURA

Plate 6, Figures 50–55.

1951. *Somapecten kamimanensis*, KIMURA, p. 347, pl. 1, figs. 19, 20.

Description:—Shell medium, equivalve exclusive of hinge area, depressed and biconvex, elongately ovate or orbicular in outline; ears equal, depressed, demarcated from shell body, fairly large; auricular margin with shell body long; dorsal margin in right valve rises above hinge margin but straight in left valve; extremities of ears roundedly obtuse-angled in both valves; dorsal margins (or auricular margins) straight, fairly long and forming 80–90° apical angle; ventral margin orbicular and fan-shaped; surface smooth; test thin, having very minute radial and concentric structure; internally, auricular crura short and improminent; paired triangular wing-like elevations below hinge margins; angular conical cardinal tooth, grooved at base, projected in right valve, and corresponding triangular socket in left valve; resilifer not demarcated from the tooth or socket.

Observation:—Several specimens at hand vary in size, some of which being deformed. As KIMURA stated, there are two kinds of shell outline in this species of the Sakamoto area, i. e. quite orbicular form and ovate form, much higher than long. Most Sakamoto specimens belong to the latter. Gapes on anterior lateral margins are unknown. A long but narrow axial elevation from umbo to midheight probably corresponds to the tooth and its extension.

Family Limidae

Genus *Lima* BRUGUIÈRE, 1797

Subgenus *Plagiostoma* SOWERBY, 1814

Lima (*Plagiostoma*) sp.

Plate 6, Figure 48.

A broken external mould of a left valve which lacks hinge area is referred to *Lima* (*Plagiostoma*). It is very inequilateral, a little convex, trigonally ovate, length much greater than height (L: 16 mm, H: 11 mm); antero-dorsal margin straight and three times as large as posterior, forming 110° apical angle; ventral margin rounded and antero-ventral margin projected; surface covered by about 50 radial ribs which are wider than their punctate interspaces. The obliquity of shell, many fine radial ribs and punctate interspaces of the specimen are all characteristic of *Plagiostoma*, although the hinge area is invisible.

Occurrence:—Loc. 11.

Subgenus *Ctenoides* Mörch, 1853

Lima (*Ctenoides*) *tosana* KURATA and KIMURA

Plate 6, Figures 44–47.

1951. *Lima* (*Ctenoides*) *tosana*, KIMURA, p. 349, pl. 1, figs. 22a, b.

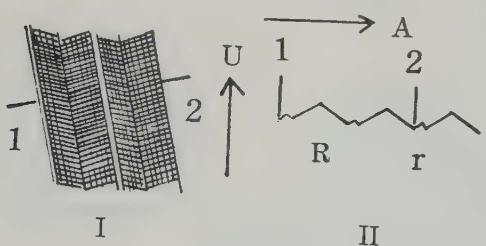
Occurrence:—Common at Locs. 4, 6, 11, 12.

Genus *Limatula* WOOD, 1839

Limatula reticulata TAMURA, new species

Plate 6, Figure 43.

Description:—Shell inequilateral, inflated, elongated, and height much greater than length; hinge margin short and straight; antero-dorsal margin slightly arcuate or nearly straight; postero-dorsal a little rounded; ventral rounded and produced; beak distinct but not pointed, a little projected beyond hinge margin; ears small, anterior one larger than posterior one, not delimited from shell body, extremity of anterior ear obtuse-angled and posterior one nearly 90°; surface covered by about 18 regular ridged radial ribs which are restricted to main part of shell body; its lateral sides smooth; posterior side of rib a little narrower than anterior one and both sides striated by numerous fine reticulate ribs, inserted by low secondary ridged radial ribs.



Text-Figure 4. Radial rib of *Limatula reticulata* TAMURA:
I: side view, II: profile of rib, 1-2: cutting place, A: anterior, U: upward, R: primary rib, r: secondary rib.

Comparison:—The external and internal moulds of a right valve (L $\gtrsim$10 mm; H: 21mm; apical angle: 50°) are present. The tall shell form and surface ornament as seen in Fig. 4 are characteristic of this species. It resembles *Limatula gibbosa* by SOW. (MOR. & LYC., 1853) but it is much obliquely expanded and the secondary ribs are inserted between primaries. *Limatula corallina* ARKELL (ARKELL, 1929) has no secondary ribs and *L. elliptica* (WHITEAVES) (ARKELL, 1930) differs from *L. reticulata*, in the striae of interspaces.

Occurrence:—Loc. 11.

References cited

ARKELL, W. J. (1930), The Generic Position and Phylogeny of Some Jurassic Aridae. *Geol. Mag., Vol. 67.*

DECHASEAUX, C. (1936), Pectinidés Jurassiques de l'Est du Basin du Paris., *Ann. Paléont., t. 25.*

FIEBELKORN, M. (1893), Die norddeutschen Geschiebe der Oberen Juraformation. *Zeits. Deutsch. Geol. Ges., Bd., 45, Berlin.*

HEALEY, M. (1908), The Fauna of the Napeng Beds or the Rhaetic Beds of Upper Burma. *Palaeont. Indica, N. S., Vol. 2, Mem. No. 4.*

KITTL, E. (1903), Geologie der Umgebung von Sarajebo. *Jahrb. k. k. geol. Reichsanst., Wien, Vol. 53.*

MASUDA, K. (1958), On the Miocene Pectinidae from the Environs of Sendai, Pt. 11. *Trans. Proc. Palaeont. Soc. Japan, N. S., No. 31.*

NEWELL, N. D. (1937), Late Paleozoic Pelecypods: Pectinacea. *Kansas Geol. Surv., Vol. 10.*

PČELINCEV, V. (1937), The Gastropoda and Pelecypoda from the Liassic and lower Dogger of the Tetis in the limits of the USSR (the Crimea and Caucasus). *Paleont. USSR Monogr., Vol. 48.*

PHILIPPI, E. (1900), Beiträge zur Morphologie und Phylogenie der Lamellibranchien: *Zeits. Deutsch. geol. Gesells., Vol. 52.*

STAESCHE, K. (1926), Die Pectiniden der schwäbischen Jura. *Geol. Palaeont. Abh., N. F., Bd. 15.*

TAMURA, M. (1959), Trigoniidae, Ostreidae, Bakevelliidae, Pteriidae, Cardiidae and Astartidae from the Upper Jurassic Sakamoto formation in Central Kyushu, Japan. *Trans. Proc. Palaeont. Soc. Japan, N. S., No. 33.*

TERQUEM, O. (1855), Paléontologie de l'étage inférieur de la formation liasique de la Province de Luxembourg, Grand-Duché

(Hollande), et de Hettange, du la Moselle. *Mém. Soc. géol. France, Sér. 2, Tom. 5.*

TROEDSSON, G. (1951), On the Höganäs Series of Sweden. *Kungl. Fysiogr. Säll. Handl., N. F., Bd. 62, Nr. 1.*

See also ARKELL (1929-31), COX (1935, 1940, 1952), KIMURA (1951, 1956), MORRIS and LYCETT (1853) in Bibliography of *Trans. Proc. Palaeont. Soc. Japan, N. S., No. 33* of this study.

Explanation of Plate 6

(All figures show side view unless denoted)

Grammatodon takiensis KIMURA

Fig. 1. Internal mould of a right valve; Loc. 9. ×2. (MM 3013).

Fig. 2. Internal mould of bivalved shell; Loc. 4. ×2. (MM 3014).

Nuculana (*Praesaccella*) *erinoensis* KIMURA

Figs. 3, 4. Internal mould and clay cast of external mould of a right valve; Loc. 5. ×1. (MM 3017).

Figs. 5, 6. Internal moulds of left valves; Loc. 2 (Fig. 5), 6 (Fig. 6). ×1. (MM 3018, 3019).

Nuculana (*Praesaccella*) *yatsushiroensis* TAMURA, new species

Figs. 7, 8. External and internal moulds of the holotype right valve; Loc. 2. ×2. (MM 3020).

Parallelodon inflatus TAMURA, new species

Fig. 9. Internal mould of a right valve; Loc. 3. ×1. (MM 3022)

Fig. 10. Internal mould of the holotype right valve; Loc. 6. ×1. (MM 3023).

Catella (*Torinosucatella*) *kobayashii* TAMURA, new species

Fig. 11. External mould of the holotype right valve; Loc. 6. ×2. (MM 3024).

Figs. 12, 16. External and internal moulds of a left valve of a bivalved shell; Loc. 6. ×2. (MM 3025).

Fig. 13. External mould of a left valve; Loc. 6. ×2. (MM 3026).

Fig. 14. Internal mould of a right valve; Loc. 6. ×2. (MM 3027).

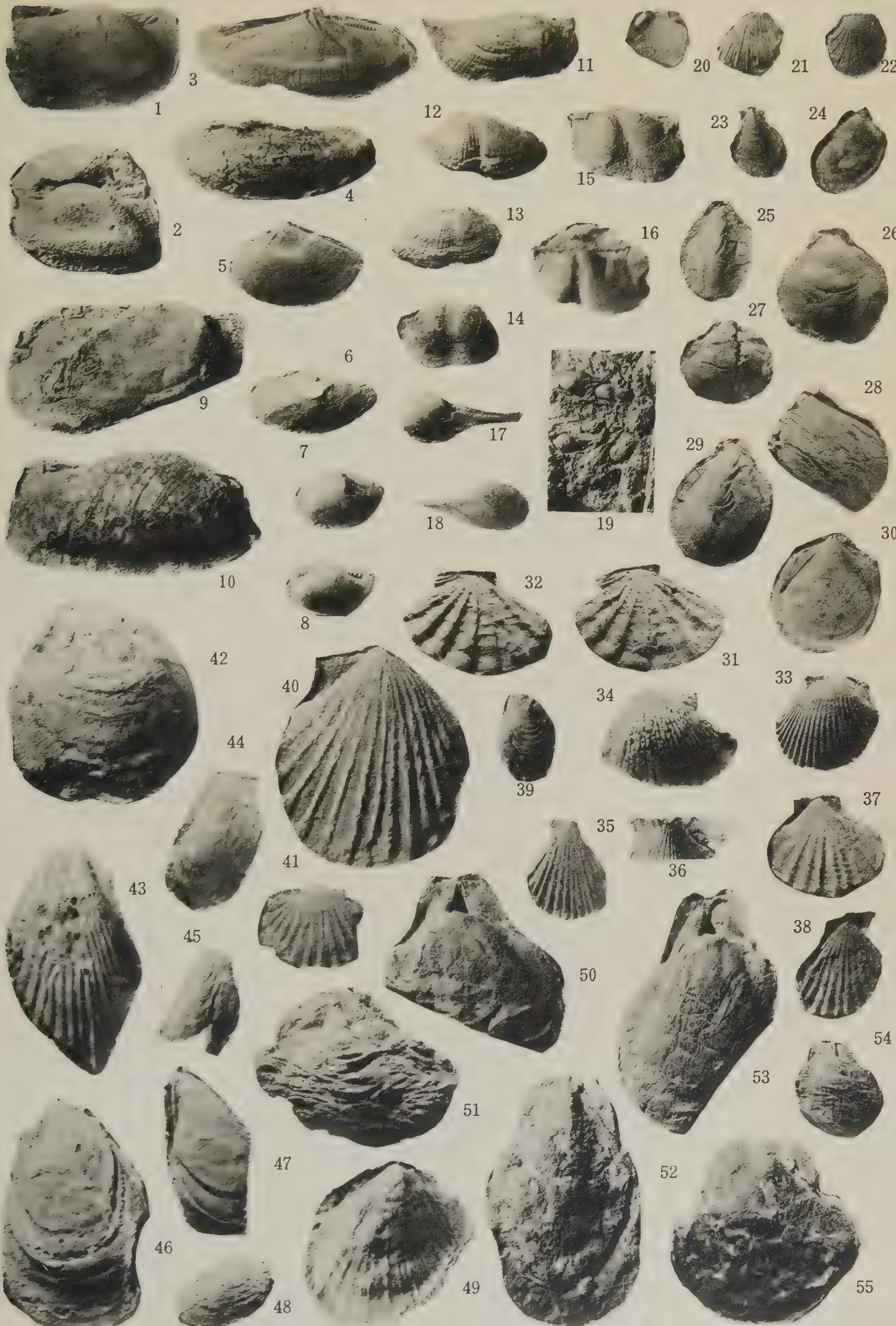
Fig. 15. Internal mould of a left valve; Loc. 11. ×2. (MM 3028).

Nuculana (*Dacryomya*) *stenodolichos* KIMURA

Fig. 17. Internal mould of a left valve; Loc. 12. ×2. (MM 3029).

Fig. 18. External mould of a right valve; Loc. 4. ×2. (MM 3030).

Fig. 19. Slab with specimens; Loc. 4. ×1. (MM. 3030).


1
2
3
4
5
6
7
8
9
10
11
12
13
14
15
16
17
18
19
20
21
22
23
24
25
26
27
28
29
30
31
32
33
34
35
36
37
38
39
40
41
42
43
44
45
46
47
48
49
50
51
52
53
54
55

Variamussium habunokawense (KIMURA)

Figs. 20, 22. External and internal moulds of a right valve; Loc. 12. ×2. (MM 3031).

Fig. 21. External mould of a fragment of a left valve; showing radial ornament; Loc. 12. ×2. (MM 3032).

Entolium kimurai TAMURA, new species

Fig. 23. Internal mould of a left valve; Loc. 12. ×1. (MM 3035).

Figs. 24, 26, 27. Internal moulds of left valves; Loc. 6. ×1. (MM 3036, 3037, 3038).

Fig. 25. Internal mould of a left valve; Loc. 2. ×1. (MM 3039).

Fig. 28. Internal mould of a right valve; Loc. 2. ×1. (MM 3040).

Fig. 29. Internal mould of the holotype left valve; Loc. 6. ×1. (MM 3041).

Entolium yatsujiense KURATA and KIMURA

Fig. 30. Internal mould of a left valve: Loc. 12. ×2. (MM 3045).

Chlamys (*Radulopecten*) *nagatakensis* KURATA and KIMURA

Figs. 31, 32. External and internal moulds of a left valve; Loc. 11. ×1. (MM 3047).

"*Aequipecten*" *kotsubu* (KIMURA)

Fig. 33. Internal mould of a left valve; Loc. 3. ×2. (MM 3048).

Fig. 34. External mould of a right valve; Loc. 11. ×3. (MM 3049).

Chlamys (*Chlamys*) *iboibo* KURATA and KIMURA

Fig. 35. Internal mould of a left valve; Loc. 11. ×2. (MM 3052).

Fig. 36. Internal mould of a right valve; showing upper part of the shell; Loc. 8. ×2. (MM 3053).

Chlamys (*Radulopecten*) *ogawensis* (KIMURA)

Fig. 37. Internal mould of a left valve; Loc. 6. ×1. (MM 3055)

Chlamys (*Chlamys*) sp.

Fig. 38. Internal mould of a right valve; Loc. 6. ×2. (MM 3057).

Camptonectes ? sp.

Fig. 39. Modeling cast of the external mould of a left valve; Loc. 8. ×3. (MM 3058).

"*Aequipecten*" *vulgaris* (KIMURA)

Fig. 40. Internal mould of a left valve; Loc. 4. ×2. (MM 3059).

Fig. 41. Internal mould of a left valve; Loc. 3. ×2. (MM 3060).

Camptonectes sp. aff. *browni* COX

Fig. 42. Left valve; Loc. 6. ×1. (MM 3063).

Limatula reticulata TAMURA, new species

Fig. 43. Modeling cast of the external mould of the holotype right valve; Loc. 6. ×1.5. (MM 3064).

Lima (*Ctenoides*) *tosana* KIMURA

Figs. 44, 45. Internal and external moulds of a left valve; Loc. 11. ×2. (MM 3065).

Figs. 46, 47. Internal mould and clay cast of a right valve; side view and showing posterior lateral side; Loc. 4. ×1. (MM 3066).

Lima (*Plagiostoma*) sp.

Fig. 48. Plaster cast of the external mould of a broken left valve; Loc. 11. ×1. (MM 3067).

Eopecten sp.

Fig. 49. Internal mould of a left valve; Loc. 11. ×2. (MM 3068).

Somapecten kamimanensis KIMURA

Figs. 50, 53. Internal moulds of right valves; Loc. 6. ×1. (MM 3069, 3070).

Figs. 51, 54. Internal moulds of left valves; Loc. 4 (Fig. 51), 11 (Fig. 54), ×1. (MM 3071, 3072).

Figs. 52, 55. Left valves; Loc. 6. ×1. (MM 3073, 3074).

All specimens are stored in Geological Institute, University of Tokyo.

Trans. Proc. Palaeont. Soc. Japan, N. S., No. 34, pp. 66-77, pl. 7, June 15, 1959

360. PELECYPODS OF THE MIZUNUMA JURASSIC IN MIYAGI PREFECTURE, WITH SOME STRATIGRAPHICAL REMARKS*

(Studies on the Liassic Pelecypods in Japan, 10)

ITARU HAYAMI

Geological Institute, University of Tokyo

水沼地方のジュラ紀斧足類： 宮城県稲井村水沼地方には向斜の東翼に沿つて志津川地方の韮ノ浜層下部に共通な斧足類を多産する地層がある．採集品に *Camptonectes* (s. s.), *Burmesia, Cuspidaria* (?) の新種があるので記載する．*Burmesia* はこの地方では *Geratrigonia hosourensis* 帯の下位に産する．この属はビルマの Napeng 層で代表される東南アジアの Noric または Rhaetic に特徴的に知られている属であるので Napeng 動物群との類似と差異を論じた．この化石層の一部は従来真野層に含められ，ドッガーと考えられていたが，化石種，層相の上から韮ノ浜層に対比されるので，当地方の層序区分と時代論は再検討を要する．詳細は別の機会に報ずる予定であるが，この化石層の下位にある厚い砂岩層は上部三畳系である可能性が強く，ジュラ系には志津川地方と殆んど同じ層序区分が適用される． 速 水 格

In Mizunuma area of Inai village, Miyagi Prefecture, Jurassic deposits show a horseshoeshaped distribution. This area occupies the southern part of the western synclinal belt of the Kitakami Jurassic (Kobayashi, 1948) and is located at the northeast of the well known locality of Anisic ammonites at Inai. Since Inai and Takahashi (1940) had commenced the stratigraphy of this area, the Jurassic sediments were investigated by Yoshida (1944, MS) and Handa (1953, MS) whose works were birefly cited respectively by Kobayashi (1948) and Onuki (1956). Their results agree with one another in the major classification and distribution of strata, although the nomenclature is confusing to a certain extent.

Lately I surveyed this area and collected fossils. As the result it was found that the stratigraphical division and chronology of this Jurassic require some emendations. In this paper I report the brief outline of the stratigraphy and describe some new pelecypods. Interesting are the occurrences of *Camptonectes* (s. s.) and *Burmesia* in the lower Liassic beds. Although fossils of this area are strongly deformed by crustal movements, most of them are specifically determinable by close comparison with the better preserved Niranohama fauna already described by Yokoyama (1904), Kobayashi and Mori (1954) and myself (1957a, b, 1958a, b, c, d).

Here I express my most sincere thanks to Prof. Teiichi Kobayashi of the University of Tokyo for his kind advices and supervision of this manuscript.

Stratigraphical Notes

In the Mizunuma district the sediments from Upper (?) Triassic to Malm form a syncline. "*Seymourites*" at Ishizaki is a solitary ammonite, but by lithological resemblance the Jurassic sequence of Mizunuma can be correlated

* Received Aug. 22, 1958; read Sept. 27, 1958.

Table 1. Division and Correlation of Mizunuma Jurassic

<table>
<tr><td colspan="4">Mizunuma Area</td><td>Shizukawa Area</td><td>Standard</td></tr>
<tr><td colspan="2">INAI and TAKAHASHI (1940)</td><td colspan="2">HAYAMI (1959)</td><td>MABUTI (1933)
em. INAI (1939) etc.</td><td></td></tr>
<tr><td>Samurai-hama gp.</td><td>Owada sh.</td><td>Arato fmt.
Aratozaki fmt.</td><td>Hashi-ura gp.</td><td>Sodenohama fmt.
Arato fmt.
Aratozaki fmt.</td><td>Malm
Dogger</td></tr>
<tr><td>Mano gp.</td><td>Mizunuma sdy. sh.</td><td rowspan="2">—hiatus—
Mizunuma fmt.
Niranohama fmt.</td><td rowspan="2">Shizu-kawa gp.</td><td rowspan="2">Hosoura fmt.
Niranohama fmt.</td><td rowspan="2">(Aalenian)
Lias</td></tr>
<tr><td rowspan="2">Shizukawa gp.</td><td rowspan="2">Mizunuma sh.
Mizunuma ss.</td></tr>
<tr><td colspan="2">Saragai fmt.</td><td>Saragai fmt.</td><td>Noric</td></tr>
<tr><td colspan="2">Inai group</td><td colspan="2">Inai group</td><td>Inai group</td><td>Anisic
Skytic</td></tr>
</table>

with that of the Shizukawa district, as shown in Table 1.

In this area there are more than 300 meters' more or less arkosic sandstones below the Niranohama formation which contains the typical Niranohama fauna and is considered the lowermost Liassic. This formation is mainly composed of bituminous shales and fine sandstones besides a thin conglomerate at the base. As a certain disconformity can be expected below the conglomerate, I am inclined to consider that the underlying barren sandstones are the correlative to the Upper Triassic Saragai formation of Shizukawa area whose upper part has been firmly dated as Noric by the abundance of *Monotis* (*Entomonotis*).

The Niranohama formation of this area contains the following pelecypods at Futamataji, a small valley, northeast of the hamlet of Mizunuma.

Parallelodon niranohamensis HAYAMI*
Modiolus bakevelloides (HAYAMI)*
Bakevellia trigona (YOKOYAMA)*
Gervillia (*Cultriopsis*) *shizukawensis* HAYAMI
Isognomon rikuzenicus (YOKOYAMA)*
Camptonectes (s. s.) *inexpectatus* HAYAMI, new species
Geratrigonia hosourensis (YOKOYAMA)*
Eomiodon lunulatus (YOKOYAMA)*
Eomiodon vulgaris HAYAMI*
Eomiodon (?) *giganteus* HAYAMI*
Yokoyamaina elliptica (YOKOYAMA)*
Thracia subrhombica HAYAMI*
Cuspidaria (?) *praenipponica* HAYAMI, new species**
Burmesia japonica HAYAMI, new species**

Among these 14 pelecypods, 12 species marked by one or two asterisks are common to the "cyrenoid-fauna" of the lower Niranohama formation of Shizukawa area. Although no vaugoniid-sandstone is represented here, the resemblances of the specific assemblage and lithology suggest that the two faunas are almost coeval. At Futamataji, the following sequence of this formation is found in descending order.

25m+. Light grey medium sandstone (barren of fossils).

* These forms were already described on better preserved specimens from Niranohama and some other localities, and their descriptions are mostly omitted in this paper.

** Several specimens from Niranohama are identifiable with these species.

6m. Black bituminous shale with *Modiolus, Thracia* and *Cuspidaria* (?).

11m. Black fine sandstone with *Parallelodon, Modiolus, Bakevellia, Gervillia, Isognomon, Camptonectes, Geratrigonia, Eomiodon lunulatus, E. vulgaris, Yokoyamaina, Protocardia.*

30m. Black bituminous sandstone and shale (barren of fossils).

12m. Black bituminous shale with *Bakevellia, Eomiodon vulgaris, Cuspidaria* (?) and *Burmesia.*

35m. Black fine sandstone (barren of fossils but for plant fragments).

2m. Basal conglomerate containing numerous pebbles (7cm. in max. diameter) of underlying rocks.

—— disconformity ——

Dark grey sandstone of the Saragai (?) formation.

This locality has hitherto been included in the "Mano group". INAI and TAKAHASHI (1940) listed *Arcomya* sp. (aff. *A. cornuta* M.), *Pleuromya* sp. (cf. *P. recurva* GOLDFUSS), *Macrodon* cf. *hirsonensis* D'ARCHIAC and *Gervillia* sp. (cf. *Gervillia ferruginea* BENECKE) from this horizon and suggested Dogger for the group. Many other fossil localities are zonally traceable in this area from Futamataji to the northern slope of Kusakariyama (375.0 meter's peak) where I (1957b) reported *Gervillia* (*Cultriopsis*) *shizukawensis* and *Gervillia* sp. These localities are considered almost of the same horizon. Anyhow, the pelecypod fauna at Futamataji is lower Liassic instead of Dogger, and the "Mano group" is at least in part synchronous with the Shizukawa group.

It is interesting that this fauna is fairly similar in the generic assemblage to the Rhaetic (or Noric) Napeng fauna of Upper Burma and its equivalent in Indochina. *Parallelodon, Bakevellia, Gervillia, Isognomon, Thracia, Cuspidaria* (?) and *Burmesia* are important constituents also in that fauna. But the Napeng fauna is characterized by *Bakevellia praecursor* and "*Pteria*" *contorta*, which are considered important Rhaetic indices, while the present fauna lacks any Triassic elements. The occurrences of *Burmesia* have been restricted to the Upper Triassic of Southeastern Asia (Burma, Indochina and Molucca) and Jordan Valley (?), but *Burmesia japonica*, n. sp. is probably a lower Liassic species, because in Shizukawa and this areas it is found in one bed altogether with *Eomiodon* and other pelecypods which are quite different from Upper Triassic faunas hitherto known in Japan. The resemblance between the Napeng and the present fauna may be primarily due to similar sedimentary environments. This presumption is endorsed by the Shinatani fauna in the Kuruma group which is dated as Domerio-Toarcian but contains also somewhat similar genera to the Napeng and Niranohama beds (KOBAYASHI et al., 1957). I made some other stratigraphical and tectonic observations in this area, but the results will be reported on another occasion.

Description of Species

Family **Parallelodontidae** DALL

Genus *Parallelodon* MEEK and WORTHEN, 1866

(=*Macrodon* BUCKMAN, 1844, non MÜLLER, 1842)

Parallelodon niranohamensis HAYAMI

Plate 7, Figures 1, 2.

1958. *Parallelodon niranohamensis* HAYAMI, *Japan. Jour. Geol. Geogr., Vol. 29, Nos. 1 3*, p. 100, pl. 7, figs. 1 4.

An internal mould (Fig. 1) shows nearly vertical granular median denticles and weakly crenulated subhorizontal

elongated posterior teeth. An external mould reveals numerous fine radial threads and irregular concentric growth-lamellae. The holotype from Shizukawa area has a more similar dentition to *Parallelodon rugosus* (BUCKMAN) in ARKELL (1930) than *Arca keyserlingii* D'ORBIGNY in ARKELL, as noted before. Then I considered that the inclination of median denticles is important and that *Cosmetodon* BRANSON (1942) (=*Beushausenia* in ARKELL's sense) is subgenerically distinguishable from *Parallelodon* (s. s.) by the divergent median denticles from the base of hinge-plate as in *Grammatodon*, even if the undeveloped posterior wing, which was regarded as the subgeneric character of *Beushausenia* by ARKELL (1930), is not a diagnostic criterion. According to COX's personal communication* received on 26th, May, 1958, however, no generic or subgeneric distinction can be based on the hinge-teeth, which are very similar between *P. rugosus* and *Arca keyserlingii* D'ORBIGNY, type species of *Cosmetodon* BRANSON (1942).** In the inclination of median denticles these Mizunuma specimens are somewhat different from the holotype and fairly similar to *Parallelodon buckmani* RICHARDSON in ARKELL (1930) from the lower Lias of England. But it is only due to intraspecific variation, for their outline and surface ornaments are the same to the Niranohama specimens. It is concluded that the dentition of this species is fairly variable and that the difference in inclination of median denticles generally does not serve for distinction of subgeneric or higher category in parallelodontids.

Occurence:—Rare at Futamataji, northeast of Mizunuma.

Family **Bakevelliidae** KING

Genus *Bakevellia* KING, 1848

Bakevellia cf. *trigona* (YOKOYAMA)

Plate 7, Figure 3.

cf. 1904, *Gervillia trigona* YOKOYAMA, *Jour. Coll. Sci. Imp. Univ. Tokyo, Vol. 18, Art. 6*, p. 12, pl. 2, figs. 7 and 8 (?).
cf. 1957, *Bakevellia trigona*, HAYAMI, *Japan. Jour. Geol. Geogr., Vol. 28, Nos. 1-3*, p. 51, pl. 2, figs. 1-5.

Represented by an internal mould of left valve (MM 2926, 88.5 mm. long; 51.0 mm. high; 11.5+mm. thick). Shell large for genus, reverse trigonal, moderately inflated, much longer than high; hinge-line as long as shell; posterior wing small, flattened, defined by slightly sigmoidal postero-ventral margin; hinge-plate narrow, provided with one or two oblique terminal cardinal teeth and a curved weak posterior lateral; ligament area moderate in breadth, faintly striated subhorizontal lamellae, provided with 7 or more slightly opisthocline quadrate ligament pits arranged almost equidistantly.

This specimen is undoubtedly compressed secondarily in dorso-ventral direction. In the large size and terminal cardinals, this resembles *Bakevellia magnissima* HAYAMI (1957a) from the Domerio-Toarcian of Central Japan, but coincides with *trigona* in other characters. Judging from its age, this may be a transitional form from *trigona* to *magnissima*.

Occurrence:—Mizunuma formation at

* I am greatly indebted to Dr. Leslie R. Cox of British Museum (Natural History) who kindly gave me reply to my questions on *Parallelodon* and some other pelecypod genera.

** In my opinion *Cosmetodon* BRANSON, if the subgenus is valid, is not acceptable as a substitute of *Beushausenia* COSSMANN (1897), because of the different type species.

the north of Mizunuma, more or less younger than the Hettangian Niranohama formation.

Family **Pectinidae** LAMARCK

Genus *Camptonectes* MEEK, 1864

Camptonectes (s. s.) *inexpectatus* HAYAMI, new species

Plate 7, Figures 4, 5.

Description:—Shell medium to small for genus, inequivalve, fairly inequilateral, nearly acline, not strongly inflated; antero-dorsal margin of main body slightly sinuated in each valve, while postero-dorsal one is nearly straight; umbo lying near mid-point of shell length but at about two-thirds of hinge-line from front, very slightly prosogyrous; apical angle probably about 115 degrees, though the value is with no accuracy because of deformed material, and may be more or less smaller in early stage; auricles of two valves very unequal in size and shape; right anterior one, i. e. byssal auricle, protruded forwards, of *Chlamys*-type, about twice as long as posterior one, defined from main body by an auricular sulcus, deeply excavated to form a byssal notch; ctenolia distinct, five or more in number; left anterior auricle very large, subtrigonal with a slightly convex anterior margin, truncated subvertically at corner, ill-defined from main body; posterior auricle of each valve comparatively small, trigonal, truncated obliquely, well defined; surface of main body and auricles but for byssal one ornamented with numerous fine flabellate characteristic *Camptonectes*-striations which are never punctate, often bifurcated near ventral periphery of left valve and strongly bent up in both lateral areas; umbonal region almost smooth; concentric lamellae somewhat regularly spaced but restricted to anterior part of each valve; on left anterior auricle more than ten erect subvertical lamellae countable already from early stage and abruptly strengthened in middle stage; in later stage some of them continuous to anterior part of main body and fading away downwards from inner side; byssal auricle marked with numerous concentric lamellae of growth, while they are very weak on posterior one of each valve; resilifer triangular, completely internal; hinge and crural teeth absent; musculature unknown.

Measurement in mm.	Length	Height	Thickness
Holotype (MM 2927) left ex. mould	12.5+	19.5+	2.5
Paratype (MM 2928) right in. mould	27.5	25.0	4.0

Observation and Comparison:—Four specimens are more or less broken or deformed. The holotype (Figs. 4a-c) shows nearly complete antero-dorsal part of left valve, ill-defined anterior large auricle, typical *Camptonectes*-striations and prominent concentric lamellae. The paratype (Fig. 5) reveals almost complete outline of right valve, resilifer and distinct ctenolia, though more or less compressed in dorso-ventral direction. The mode of surface-markings may be somewhat different between two valves. In right valve *Camptonectes*-striations are comparatively weak and increase their number by insertion, but mainly by bifurcation in left valve.

Several species with *Camptonectes*-

striations appeared already in the Permian of North America (NEWELL, 1937) and again in the Upper Triassic of Japan (NAKAZAWA, 1952), but this genus flourished most extensively in Aalenian and later times. So far as I am aware, there are few representatives of true *Camptonectes* in the Lias (exclusive of Aalenian) except for *Camptonectes psilonoti* STAESCHE (1926) and *Camptonectes* sp. in DECHASEAUX (1936, p. 29, pl. 4, figs. 7–8). STAESCHE and DECHASEAUX considered that *Pecten punctassimus* QUENSTEDT (1856; TERQUEM and PIETTE, 1868) from the Hettangian of Lorraine and some other areas is intermediate between *Chlamys* and *Camptonectes*, but COX (1952) did not accept STAESCHE's phylogenetical concept from finely ribbed *Chlamys* to *Camptonectes* during Liassic times. The present species is a lower Liassic one belonging to *Camptonectes* (s. s.) defined by COX (1952), and therefore suggests the presence of a lineage independent from other pectinid genera, which was originated probably in such older species as mentioned above and persistent throughout the Lias. Another problem exists in the relationship between *Camptonectes* and *Entolium*. Similarly flabellate surface striae are actually seen in several species of entoliids, *Pecten* (*Syncyclonema*) *quotidianus* HEALEY (1908) for example. But such forms have typical hinge-characters of the Amusiidae, and the resemblance of surface ornaments may be superficial.

This species is somewhat similar to *Camptonectes lens* (SOWERBY) (1818), type of the genus. The species and its close allies flourished world-widely from Aalenian to Oxfordian. Though the synonymy among them was discussed repeatedly by many authors, this species differs from any hitherto described as *Camptonectes lens, C. auritus, C. arcuatus* and *C. aratus* from Europe, India, and South America in having non-punctate surface, more prominent concentric lamellae on large left anterior auricle and anterior part of main body. In these respects this may be more related to *Camptonectes laminatus* SOWERBY (1821) from the Dogger of England, New Zealand and Argentina. According to ARKELL (1930b), *C. laminatus* is distinguishable from *lens* by the large left anterior auricle which bears some ten conspicuous raised verticle lamellae (12 to 20 in full-grown specimens). This species is, however, separable from *laminatus* by the absence of strong concentrics on posterior auricle of each valve and longer hinge line. Judging from SOWERBY's and ARKELL's figures, that species has probably more slender outline with a smaller apical angle than this. *Camptonectes albertensis* WARREN (1932) from the Dogger of Alberta seems also related to this in the outline and the inequality of auricles of left valve. The surface of the Canadian specimen may be exfoliated as noted by himself, and further comparison is difficult. But this is presumably different from it because neither radial nor concentric ornaments are discernible on left anterior auricle of that species. *Camptonectes* sp. in DECHASEAUX (1936, loc. cit.) from the Pliensbachian of Paris basin and *Camptonectes psilonoti* STAESCHE (1926) from the middle Lias of Swabia may be other intimate forms, but their concentric lamellae are probably much weaker. This is easily distinguishable from several Jurassic camptonectids described in Japan (KIMURA, 1951; HAYAMI, 1957c), since those species have no surface striae of *Camptonectes*-type. They should be rather excluded from *Camptonectes*, though no suitable genus for them is not yet found in any foreign literature.

Occurrence:—Rare at Futamataji. This is the first pectinid from so-called "cyrenoid beds" of the Shizukawa faunal province.

Family **Trigoniidae** LAMARCK

Genus *Geratrigonia* KOBAYASHI, in KOBAYASHI and MORI, 1954

Geratrigonia hosourensis (YOKOYAMA)

Plate 7, Figures 6-8.

1904, *Trigonia hosourensis* YOKOYAMA, *Jour. Coll., Sci. Imp. Univ. Tokyo, Vol. 18, Art. 6*, p. 11, pl. 1, fig. 3.

1954. *Geratrigonia hosourensis* KOBAYASHI, in KOBAYASHI and MORI, *Japan. Jour. Geol. Geogr., Vol. 25, Nos. 3-4*, p. 171, pl. 15, figs. 1-2.

1954, *Geratrigonia hosourensis* var. *convexa* KOBAYASHI in KOBAYASHI and MORI, *Ibid., Vol. 25, Nos. 3-4*, p. 172, pl. 16, figs. 9a-b.

Many specimens are identical with the holotype. Although all are more or less deformed, some observations on the ontogeny, specific variation and ecology of this species are added here.

In the largest specimen illustrated in Fig. 6, subconcentric costae on the disk are somewhat effaced in the middle part, rising up in lateral sides. On the posterior side of disk oblique costae are bluntly tuberculated. In another specimen in Fig. 7, however, costae are never effaced, more or less V-shaped and fairly irregular in antero-ventral area. Some small specimens as in Fig. 8, which represent the early stage of this species, show regular concentric costae and sharp marginal carinae, and are very similar to the specimen from Niranohama which KOBAYASHI distinguished as var. *convexa* from typical *hosourensis*. These specimens were found at one horizon in this area, and the difference of costation should be at all attributed to variation within one species. Most adult specimens belonging to my collection show more or less V-shaped costae on the disk, and such a tendency can be seen to some extent also in the holotype and some other Niranohama specimens.

Geratrigonia is an aberrant genus, and its distribution is still restricted to the Lias of Japan. KOBAYASHI referred it provisionally of the Trigoniinae (=Costatae), though the marginal carina is very weak and the area very smooth for the subfamily. Most species of Jurassic trigoniids in Japan occur in more or less calcareous coarse sandstones which were formed presumably in certain littoral conditions and contain often cross-laminations indicating the agitation of sea-water. But *Geratrigonia* alone occurs chiefly in bituminous shales and fine sandstones together with *Modiolus, Bakevellia, Isognomon, Eomiodon, Yokoyamaina, Thracia* and *Cuspidaria* (?) which are hitherto called "cyrenoid fauna". As discussed before (HAYAMI, 1958b), they must have been marine inhabitants instead of brackish ones. Judging from the rock-facies and mode of fossil occurrence, however, such a bituminous sedimentation must have undergone in a certain profound embayment where sea-water was fairly stagnant and the physical and chemical conditions are very different from those of normal trigoniid-sandstones. The peculiar feature of this genus may be attributed to the adaptation to such an environment.

Occurrence:—Common at Futamataji and the south of Kusakariyama.

Family **Cuspidariidae** FISCHER

Genus *Cuspidaria* NARDO, 1840

(=*Neaera* GRAY, 1833, non ROBINEAU-DESVOIDY, 1830)

Cuspidaria (?) *praenipponica* HAYAMI, new species

Plate 7, Figures 9–12.

1958, *Cuspidaria* (?) b sp. indet., HAYAMI, *Trans. Proc. Pal. Soc. Japan, N. S., No. 30*, p. 198, pl. 28, figs. 20–21.

Description:—Shell small, slightly inequivalve, highly inequilateral, rostrated and elongated posteriorly; test thin; antero-dorsal margin slightly convex, passing gradually into venter, while postero-dorsal one slightly sinuated, long, turned abruptly into oblique siphonal margin; ventral margin broadly arcuate but fairly concave in front of posterior carination where ventral and siphonal margins meet with an acute angle; posterior carina sharp, nearly straight, bordering posterior area which is very flattened and occupies about a sixth of whole surface; posterior gaping, if present, very narrow; right valve having a less inflated main body and more distinct ante-carinal sulcus than left; several conspicuous concentric wrinkles present on surface in early stage but probably much weakened later; ventral and posterior areas marked only with faint concentric lines of growth; hinge-teeth and chondrophore unknown, probably undeveloped.

Measurement in mm.	Length	Height	Thickness
Holotype (MM 2932) left in. mould	17.5	12.0	4.0
Paratype (MM 2935) right valve	11.0	6.5	2.0

Observation and Comparison:—Although most specimens are strongly deformed, the original outline may be best preserved in the holotype (Fig. 9). This species is certainly conspecific with *Cuspidaria* (?) b sp. from Niranohama. The two Niranohama specimens are probably young shells, and quite similar to many small specimens from this area in outline and umbonal concentrics. *Cuspidaria* (?) a sp. in HAYAMI (1958d, p. 197, pl. 28, figs. 16–19) from the Domerio-Toarcian of the Kuruma group is also very similar to this. But I presume that the two forms are specifically different, judging from the subvertical siphonal margin, less prominent posterior carina and absence of concentric ribs in that form. These two forms are, of course, not typical cuspidariids, and their taxonomic positions cannot be decided because of ignorance of internal structure. Several similar species appeared in the Upper Triassic and Jurassic of Southeastern Asia. "*Cuspidaria*" *ayabensis* NAKAZAWA (1956) from the Carnic of Japan, *Cuspidaria* sp. in HEALEY (1908) from the Rhaetic (or Noric) of Burma, *Cuspidaria latecaudata* SAURIN (1941) from the Noric (?) of Annam and *Neaera sambasana* VOGEL (1900) from the Jurassic of Borneo are certainly congeneric with this. As noted on Niranohama specimens before, this is probably an ally to *N. sambasana*, but differs from it in the weaker ante-carinal sulcus and not sinuated pre-umbonal margin. *Cuspidaria latecaudata* is quite similar to this in general outline and strength of posterior carination. Its further close comparison with this is impossible at present, because both species are represented by more or less strongly deformed specimens.

Occurrence:—Common in black shales at Futamataji and the south of Kusakariyama.

Family **Burmesiidae** HEALEY

Genus *Burmesia* HEALEY, 1908

Burmesia japonica HAYAMI, new species

Plate 7, Figures 13-18.

Description:—Shell small for genus, equivalve, subequilateral, elongate-oval, not strongly inflated, not carinated, more or less gaping antero-ventrally and posteriorly; test thin; ventral margin broadly arcuate but abruptly bent up laterally, serrated at antero-ventral gaping; umbo suborthogyrous, submesial, slightly rising above hinge-line; surface marked with about 35 narrow but elevated radial plicae except for posterior area; radials most dense in middle, becoming gradually sparse towards both sides, sometimes increasing their number by insertion; concentrics somewhat lamellose, fairly strong and widely spaced in posterior area where radials are absent or much weakened; in anterior part intervals of radials excavated roundly, marked with numerous concentric lamellae; sometimes a narrow smooth belt appears in central part: hinge apparently edentulous; chondrophore and ligament unknown.

Measurement in mm.	Length	Height	Thickness
Holotype (MM 2936) left ex. mould	27.5	11.5	3.5
Paratype (MM 2937) right in. mould	23.0	8.5	3.0+

Observation and Comparison:—Among many deformed specimens, the holotype and paratype are best preserved, showing probably original outline and surface-making of this species. The dissimilarity among illustrated specimens is principally due to secondary deformation. The holotype is slightly broken in antero-dorsal part, but the antero-ventral gaping is presumable from growth-lines.

Genus *Burmesia* was originally founded on two species from the Rhaetic (or Noric) Napeng beds in Upper Burma. But the two seem fairly different in the mode of costation: more precisely, *Burmesia lirata* has several oblique costae on the anterior area which remind at a glance one of those of *Goniomya*, while in *Burmesia latouchii* the anterior area is marked with simple fine radials. The type-species of *Burmesia* was not selected by HEALEY herself, and DIENER's designation (1923) on *B. latouchei* (? misspelling of *latouchii*) is probably the first. Anyhow, I do not consider here that such oblique costation is a diagnostic character of the genus. The taxonomic position of *Burmesia* has not yet been settled. HEALEY proposed the Burmesiidae, but WANNER and KNIPSCHEER (1951) referred it to the Anatinidae (=Laternulidae).

This species resembles closely *B. latouchii* in the general outline and distribution of radials, but the shell is much smaller and more elongated horizontally than the Napeng species. *B. lirata* in MANSUY (1921) and PATTE (1922) from the Noric of Indochina shows similar outline, but the radial plicae of this species are more densely spaced on the middle shell-surface. *Burmesia praecursor* KRUMBECK (1913) and *B. weberi* WANNER and KNIPSCHEER (1951) from the Noric of Buru and Misol have oblique ribs in anterior part and are more similar to *B. lirata* from Napeng than to

this species. *Burmesia? posteroradiata* Cox (1924) from the Carnic of Jordan Valley seems not close to this, since its anterior half of shell is almost smooth, lacking any radial ornament.

Neoburmesia iwakiensis YABE and SATO (1942) from the Upper Jurassic of Soma area in North Japan has somewhat similar ornaments to *Burmesia*. But is is very different from this and Napeng species in the large and inflated shell, excavated ventral margin, very anterior umbo and *Arca*-like carinated outline, though it cannot be a taxodont judging from the thin test in some topotype specimens. *Pholadomya* SOWERBY (1823) has sometimes similar to *Burmesia*, but the latter is distinct from the former in having a chondrophore and characteristic radials which are densely spaced especially in the middle part of shell and become gradually sparse and obscure towards both sides. *Myopholas acuticostata* var. *nana* DOUVILLÉ (1907) in LISSAJOUS (1923) from the Bathonian is somewhat similar to this mode of costation, but the radials are more sparse than in this species.

Occurrence:—Common at Futamataji. This species is found in some black shales about 30 meters below the *Geratrigonia hosourensis* beds. It is the first Liassic species of *Burmesia*. Several fragmental specimens were procured also at Niranohama of Shizukawa area.

References

ARKELL, W. J. (1930a), The generic Position and Phylogeny of some Jurassic Arcidae. *Geol. Mag., Vol. 67*,

—— (1930b, 1933), A Monograph of British Corallian Lamellibranchia. *Palaeontogr. Soc. London.*

BRANSON, C. C. (1942), *Parallelodon, Grammatodon* and *Cosmetodon. Jour. Pal., Vol. 16.*

COX, L. R. (1924), A Triassic Fauna from the Jordan Valley. *Ann. Mag. Nat. Hist., Ser. 9, Vol. 14.*

—— (1952), The Jurassic Lamellibranch Fauna of Cutch (Kuchh). *Palaeont. Indica, Ser. 9, Vol. 3, Pt. 4.*

DECHASEAUX, C. (1936), Pectinidés jurassiques de l'Est du Bassin de Paris. *Ann. Paléont., Tom. 25.*

DIENER, C. (1923), Lamellibranchiate triadica II. *Fossilium Catalogus. 1. Animalia, Pars 19.*

DOUVILLÉ, H. (1907), Les Lamellibranches cavicoles. *Bull. Soc. géol. France, Sér. 4, Tom. 7.*

GOTTSCHE, C. (1867), Ueber jurassische Versteinerungen aus der argentinischen Cordillere. *Palaeontogr., Supple. 3, Lief. 2, Abt. 3.*

HEALEY, M. (1908), The Fauna of the Napeng Beds or the Rhaetic Beds of Upper Burma. *Palaeont. Indica, N. S., Vol. 2, Mem. No. 4.*

HAYAMI, I. (1957a), Liassic *Bakevellia* in Japan. *Japan. Jour. Geol. Geogr., Vol. 28, Nos. 1–3.*

—— (1957b), Liassic *Gervillia* and *Isognomon* in Japan. *Ibid., loc. cit.*

—— (1957c), Liassic *Chlamys*, "*Camptonectes*" and other Pectinids from the Kuruma Group in Central Japan. *Trans. Proc. Pal. Soc. Japan, N. S., No. 28.*

—— (1958a), Liassic *Volsella, Mytilus* and some other Dysodont Species in Japan. *Ibid., N. S., No. 29.*

—— (1958b), A Review on the Liassic so-called "Cyrenoids" in Japan. *Japan. Jour. Geol. Geogr., Vol. 29, Nos. 1–3.*

—— (1958c), Some Hettangian Pelecypods from the "*Trigonia*-sandstone" of the Shizukawa Group in North Japan. *Ibid., loc. cit.*

—— (1958d), Supplementary Descriptions of the Liassic Pelecypods from the Kuruma and Shizukawa Groups in Japan. *Trans. Proc. Pal. Soc. Japan, N. S., No. 30.*

INAI, Y. and TAKAHASHI, N. (1940), On the Geology of the Southmost Kitakami Mountainland. *Cont., Inst. Geol. Pal., Tohoku*

Imp. Univ., No. 33, (in Japanese).

KIMURA, T, (1951), Some Pectinids and a Limid from the Jurassic Torinosu Group in Japan. *Jour. Fac. Sci., Univ. Tokyo, Sec. 2, Vol. 7, Pts. 6-10.*

KOBAYASHI, T. (1948), Tectonic Geology of Japanese Islands. *Tokyo.* (in Japanese).

——, KONISHI, K., SATO, T., HAYAMI, I. and TOKUYAMA, A. (1957), On the Lower Jurassic Kuruma Group. *Jour. Geol. Soc. Japan, Vol. 63, No. 738,* (in Japanese).

—— and MORI, K. (1954), Studies on the Jurassic Trigonians in Japan. Part 2. *Prosogyrotrigonia* and the Trigoniinae. *Japan. Jour. Geol. Geogr., Vol. 25, Nos. 3-4.*

KRUMBECK, L. (1913), Obere Trias von Buru und Misol. *Palaeontogr. ,Supple. 4, Lief. 2.*

LISSAJOUS, M. (1923), Étude sur la Faune du Bathonien des Environs de Macon. *Trav. Labor. Géol. Fac. Sci. Lyon, Fasc. 5, Mém. 3.*

MANSUY, H. (1914), Description d'Espèces nouvelles des Terrains paléozoiques et triasiques du Tonkin. *Mém. Serv. géol. Indochine, Vol. 3, Fasc. 2.*

—— (1921), Nouvelle Contribution à l'Etude des Faunes des Terrains gothlandiens, dévoniens et rhétiens de la Region de la Basse Rivière noire. *Ibid., Vol. 8, Fasc. 1.*

NAKAZAWA, K. (1952), A Study on the Pelecypod-Fauna of the Upper Triassic Nabae Group in the Northern Part of

Explanation of Plate 7

Parallelodon niranohamensis HAYAMI .... Page 68

Fig. 1. Right internal mould (MM 2924), ×1. Loc, Futamatji.

Fig. 2. Clay cast of left external mould (MM 2925) ×2. Loc. ditto.

Bakevellia cf. *trigona* (YOKOYAMA) .... Page 69

Fig. 3. Left internal mould (MM 2926) ×2/3. Loc. north of Mizunuma.

Camptonectes (s. s.) *inexpectatus* HAYAMI, new species .... Page 70

Fig. 4a. Left external mould (MM 2927), holotype, ×1. Loc. Futamataji.

Fig. 4b. The same specimen, ×2.5.

Fig. 4c. Clay cast of the same specimen, ×2.5.

Fig. 5. Right internal mould (MM 2928), paratype. ×1. Loc. ditto.

Geratrigonia hosourensis (YOKOYAMA) .... Page 72

Fig. 6. Clay cast of right external mould (MM 2929) ×1. Loc. ditto.

Fig. 7. Clay cast of right external mould (MM 2930) ×1. Loc. south of Kusakariyama.

Fig. 8. Clay cast of left external mould (MM 2931) ×2. Loc. ditto.

Cuspidaria (?) *praenipponica* HAYAMI, new species .... Page 73

Fig. 9. Left internal mould (MM 2932), holotype, ×2. Loc. Futamataji.

Fig. 10. Clay cast of left external mould (MM 2933) ×2. Loc. ditto.

Fig. 11. Left internal mould (MM 2934) ×2. Loc. ditto.

Fig. 12. Right valve (MM 2935), paratype, ×2. Loc. ditto.

Burmesia japonica HAYAMI, new species .... Page 74

Fig. 13a. Left external mould (MM 2936), holotype, ×2. Loc. ditto.

Fig. 13b. Clay cast of the same specimen, ×2.

Fig. 13c. Clay cast of the same specimen, ×1,

Fig. 14. Right internal mould (MM 2937), paratype, ×2. Loc. ditto.

Fig. 15. Clay cast of right external mould (MM 2938), ×2. Loc. ditto.

Fig. 16. Clay cast of left external mould (MM 2939), paratype. Loc. ditto.

Fig. 17. Clay cast of right external mould (MM 2940) ×2. Loc. ditto.

Fig. 18. Clay cast of left external mould (MM 2941) ×2. Loc. ditto.

All specimens illustrated here are kept in the Geological Institute, University of Tokyo.


1
2
4a
4b
3
5
8
6
7
4c
10
11
12
9
14
15
13b
17
16
13a
13c
18

Kyoto Prefecture, Japan. Part 1. *Mem. Coll. Sci., Univ. Kyoto, Ser. B, Vol. 20, No. 2.*

—— (1956), Op. cit. Part 4. *Ibid., Ser. B, Vol. 23, No. 2.*

NEWELL, N. D. (1938), Late Palaeozoic Pelecypods. *Kansas Geol. Surv., Vol. 10.*

ONUKI, Y. (1956), Explanatory Text of the Geological Map of Iwate Prefecture, vol. 2. *Iwate Pref.* (in Japanese).

PATTE, E. (1922), Études de quelques Fossiles paléozoiques et mesozoiques recueillis en Indochine et au Yun-nan. *Mém. Serv. géol. Indochina, Vol. 9, Fasc. 1.*

QUENSTEDT, F. A. (1858), Der Jura. *Tübingen.*

SAURIN, E. (1941), Lamellibranches du Trias supérieur de Hoa-Huynh (Sud-Annam). *Bull. Serv. géol. Indochina, Vol. 26, Fasc. 3.*

SOWERBY, J. (1818, 1821), The Mineral Conchology of Great Britain. Vols. 2 and 3. *London.*

STAESCHE, K. (1926), Die Pectiniden des Schwäbischen Jura. *Geol. Pal. Abhandl., N. F., Bd. 15.*

TERQUEM, O. and PIETTE, E. (1868), Le Lias inférieur de l'Est de la France comprenant la Meurthe, la Moselle, le Grand-Duché de Luxembourg, la Belgique et la Meuse. *Mém. Soc. géol. France, Sér. 2, Tom. 8.*

VOGEL, F. (1900), Neue Mollsken aus dem Jura von Borneo. *Samml. Geol. Reichs-Mus. Leiden, Ser. 1, Bd. 6, Heft 2.*

WANNER, J. and KNIPSCHEER, H. C. G. (1951), Beiträge zur Paläontologie des Ostindischen Archipels. XX. Neue Versteinerungen aus den norischen *Nucula*-Mergeln von Misol. *Neues Jahrb. f. Geol. u. Pal., Abh., Bd. 94.*

WARREN, P. S, (1932), A new Pelecypod Fauna from the Fernie Formation, Alberta. *Trans. Roy. Soc. Canada, Ser. 4, Vol. 26.*

YABE, H. and SATO, S. (1942), A new Bivalve from the Jurassic Torinosu Series of the Abukuma Mountainland. *Proc. Imp. Acad. Tokyo, Vol. 18, No. 5.*

YOKOYAMA, M. (1904), On some Jurassic Fossils from Rikuzen. *Jour. Coll. Sci., Imp. Univ. Tokyo, Vol. 18, Art. 6.*

Trans. Proc. Palaeont. Soc. Japan, N. S., No. 34, p. 78, June 15, 1958

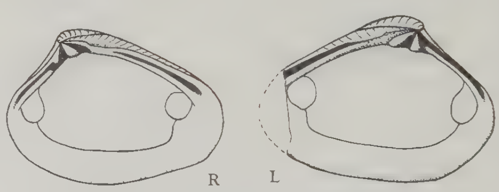
SHORT NOTES

3. AN ADDITIONAL NOTE ON THE LIASSIC "CYRENOIDS" IN JAPAN

ITARU HAYAMI

Geological Institute, University of Tokyo

Soon after my revision (1958) had been published, I read CASEY's (1955) of Neomiodontidae, nov. His new family, which includes *Eomiodon* COX, 1935, *Myrene* CASEY, 1955, *Cyrenopsis* ETHERIDGE, 1902 and *Musculiopsis* MACNEIL, 1939 besides *Neomiodon* FISCHER, 1887 (=*Protomiodon* ANDERSON and COX, 1948), and may be the forerunner of the Corbiculidae. Accepting his opinion, I transfer *Eomiodon lunulatus*, *E. uulgaris*, *E.* sp., *E.* (?) *giganteus* and *E.* (?) sp. from the Arcticidae to the Neomiodontidae. In the hinge structure *E. lunulatus* (YOKOYAMA) (Text-figs.) from lower Lias is quite similar to *Eomiodon cuneatus* (SOWERBY) (CASEY, p. 210, figs. 1–3) but for the worse-defined cardinal tooth 5b from nymph and developed lateral PIII. Other features are diagnostic of the genus. Liassic *Crenotrapezium kurumense* HAYAMI is allied to *Neomiodon* as well as *Eotrapezium*. In the carinated trigonal outline and position of cardinals it seems more similar to *Eotrapezium* but to *Neomiodon* in the lateral teeth. Compared with CASEY's hinge of *Neomiodon* (p. 210, fig. 7), the inner lateral teeth are more distinctly crenulated. In this respect the Japanese species is closer to *Myrene* than *Neomiodon*, but the posterior laterals are double in the right valve and single in the left as in *Neomiodon* (single in the right and double in the left in *Myrene*). It is presumably transitional between *Eotrapezium* and *Neomiodon* (or *Myrene*) and located also in the Neomiodontidae. It bears importance on phylogeny that the family is well represented already in the Lias of Japan.



Text-figs. Hinge structures of *Eomiodon lunulatus* (YOKOYAMA)
R: restored from a right internal mould (MM 2837) ×1.
L: restored from a left internal mould (MM 2841) ×1.2.

References

CASEY, R. (1955), The Neomiodontidae, a new Family of the Arcticacea (Pelecypoda). *Proc. Malac. Soc. London, Vol. 31, Pts. 5, 6.*

HAYAMI, I. (1958), A Review on the so-called Liassic "Cyrenoids" in Japan. *Japan. Jour. Geol. Geogr., Vol. 29, Nos. 1–3.*

Trans. Proc. Palaeont. Soc. Japan, N.S., No. 34, pp. 79-85, pl. 8, June 15, 1959

361. NOTE ON SOME PERMIAN CORALS FROM FUKUJI, HIDA MASSIF, CENTRAL JAPAN*

HISAYOSHI IGÔ

Institute of Geology and Mineralogy, Tokyo University of Education

飛驒山地福地産二畳系珊瑚化石について：飛驒山地福地附近に発達する二畳系水屋が谷層，空山層から産した珊瑚化石のうち3新種・1新亜種・2未定種を記載し，水屋が谷層が珊瑚化石の上からも下部二畳系である点を強調した．　猪郷久義

Introduction and Acknowledgements

In this paper several corals collected from the Permian Mizuyagadani and Sorayama formations developed at Fukuji, Kamitakara Village, Yoshiki County, Gifu Prefecture (IGÔ 1957) are described and their stratigraphic significance is discussed. The Lower Permian Mizuyagadani formation is roughly subdivided into the lower or *Pseudoschwagerina*-limestone and upper or clastic sediments. The next younger Sorayama formation consists of a remarkable basal conglomerate (Osobudani conglomerate) conformably overlain with agglomeratic schalstein or volcanic conglomerate (Sorayama conglomerate and schalstein).

The corals treated herein are *Sochkineophyllum japonicum* IGÔ, n. sp. and *S. japonicum pauciseptatum* IGÔ, n. subsp. from the calcareous tuff bed developed in the Mizuyagadani valley; *Amandophyllum* sp. from the thin conglomerate or conglomeratic shale of the middle part of the Mizuyagadani formation developed at the junction of the Takadani and Osobudani valleys; *Iranophyllum tunicatum* IGÔ, n. sp., *Wentzelella osobudaniensis* IGÔ, n. sp., and *Lonsdaleiastraea?* sp. from the limestone pebbles of the Osobudani conglomerate at the type locality.

Here I thank Professors Haruyoshi FUJIMOTO and Wataru HASHIMOTO of the Institute of Geology and Mineralogy, Tokyo University of Education for their kind guidance throughout the present study. Acknowledgements are due to Professor Kotora HATAI of the Department of Geology, Faculty of Education, Tohoku University for his encouragement, and Professor Masao MINATO of the Institute of Geology and Mineralogy, Hokkaido University for his advice received in 1953, and Mr. Tadao KAMEI of the Institute of Geology, Shinshu University, for his cooperation in the field. Thanks are also due to the Ministry of Education, Japanese Government and the Asahi Press for grants from their Scientific Expenditure Funds awarded to Professor H. FUJIMOTO.

Stratigraphical Note

The two new forms of *Sochkineophyllum* were collected from a green and red calcareous tuff bed in the lower part of the Mizuyagadani formation, which directly covers the *Pseudoschwagerina*-limestone. This about 10 meters thick bed at the type section which yielded abundant specimens of brach-

* Received Sept. 25, 1958, read Feb. 2, 1958.

iopods, corals, bryozoans, and fragments of crinoid stems, graded upwards into tuffaceous shale. Recently KAMEI (1957) described *Plerophyllum hidense* KAMEI and *Huangia mizuyagadaniensis* KAMEI from this bed.* He also reported on the occurrence of *Squamularia asiatica* CHAO, *Spiriferella* cfr. *salteri* TSCHERNYSCHEW and other unidentified brachiopods. KAMEI insisted that the coral-brachiopods faunule belongs to the Zone of *Parafusulina* and, therefore, is Artinskian in age. However, I consider that the larger part of the Mizuyagadani formation may represent the Zone of *Pseudoschwagerina* and is, therefore, Sakmarian in age from the following facts.

Sochkineophyllum japonicum Igô, n. sp., and *S. japonicum pauciseptatum* Igô, n. subsp. from the calcareous tuff bed resemble *S. artiense* (SOSHKINA) and *S. tenuiseptatum* (SOSHKINA) from the Artinskian of the west slope of the northern Urals, Soviet Russia, but our forms are specifically distinct from the latters. Recently I found *Pseudofusulina vulgaris* (SCHELLWIEN) and other related thick walled-type *Pseudofusulina* from the matrix of the conglomerate or conglomeratic shale lying slightly above the *Sochkineophyllum*-bed. Although rare they are favorably preserved in fine grained shale and based upon the mode of occurrence, these fusulinids may be contemporaneous or penecontemporaneous with the deposition of this bed. The same fusulinids are common in the Nyukawa group which is widely developed in the south of the present district and they are frequently associated with abundant *Pseudoschwagerina*. This faunal relationship is known from other localities of the Japanese Lower Permian rocks. *Amandophyllum* sp. also occurs from the limestone breccia of the same horizon. This unnamed species is somewhat related to *Amandophyllum carnicum* (HERITSCH) which was reported from the Upper Auernig series (Upper Kalkreich group) in the Carnic Alps, Austria. The brachiopods listed by KAMEI are rather long range types and are not restricted to the Artinskian.

On the other hand the corals from the limestone pebbles of the Osobudani conglomerate indicate the late Early Permian or slightly younger age than the Mizuyagadani. *Iranophyllum tunicatum* Igô, n. sp. resembles *I. splendens* DOUGLAS from the Lower Permian of Tapileh Valley, Darreh Dazen, Southwest Iran. In the present area it is associated with *Pseudofusulina duplithecata* Igô, *P.* spp., *Nankinella kotakiensis* (FUJIMOTO and KAWADA), *N. kawadai* (Igô) and others (Igô, 1956a, b). Although *Wentzelella osobudaniensis* Igô, n. sp. and *Lonsdaleiastraea* ? sp. are not sufficient for determination of the geological age they may represent a slightly higher position than *Iranophyllum*. These corals were apparently derived from the Mizuyagadani formation before the deposition of the Osobudani conglomerate. It should be made clear that no fossils have been collected which definitely indicate the existence of the Zone of *Parafusulina* from the pebbles of the Osobudani. Unfortunately the age of neither the Sorayama formation nor the Osobudani conglomerate can be determined with accuracy, but there remains a great probability that either the Zone of *Parafusulina* is represented in only the uppermost part of the Mizuyagadani and was partly denudated during the pre-Osobudani hiatus or that the Sorayama corresponds to the Zone of *Parafusulina*.

* It is doubtful that the latter species was derived from this bed.

Description of Species

Family Polycoeliidae ROEMER, 1883

Subfamily Polycoeliinae ROEMER, 1883

Genus *Sochkineophyllum* GRABAU, 1928

Sochkineophyllum japonicum IGÔ, n. sp.

Plate 8, figures 4a, b.

Corallum solitary; corallite small, slightly curved cylindrical with turbinate proximal part. Diameter of corallite 13 mm and length about 40 mm at maturity. Outer wall rather thick and externally with well developed concentric rings, septal grooves less distinct.

Major septa 26 in number at diameter of 13 mm, and 22 at 9 mm. They are arranged more or less pinnately, considerably thickened by stereoplasmic deposits, and remarkably accelerated in counter quadrants. In adult stage, counter and two alar septa very outstanding and extend to near center. Cardinal septum rather long in premature stage but considerably absorbed at maturity. Counter septum straight, slightly swollen and somewhat pendant-shape. In cardinal quadrants two pairs of distinct metasepta developed and almost as thick as alar septa. Several major septa in counter quadrants flexible near axial edges. Alar septa outstanding throughout growth. Minor septa well developed but short and restricted to peripheral part. In young stage they appear as counter quadrants.

In longitudinal section subhorizontal or undulated and thin tabulae rather coarsely spaced and cross corallites. No dissepiments recognized.

Remarks:—This new species more closely resembles *Sochkineophyllum artiense* (SOSHKINA) than any other described species. However, it differs from the latter in the smaller corallite at maturity, insertion of metasepta and less distinct cardinal fossula. It is easily distinguishable from *S. tenuiseptatum* (SOSHKINA) by the more distinct thickening of the major septa near the axial edges and well developed tertiary septa in the Fukuji species.

Occurrence:—The Mizuyagadani Valley; middle part of the Mizuyagadani formation.

Geological age:—Early Permian, the Zone of *Pseudoschwagerina*.

Reg. nos.* 21003 (Holotype), 21013 (Paratype).

Sochkineophyllum japonicum paucuseptatum IGÔ, n. subsp.

Plate 8, figures 5a, b, 6.

Corallum solitary; corallite small, cylindrical with turbinate proximal end, about 60 mm and 11 mm in length and diameter, respectively. External wall thick and concentric rings well observed at surface of corallite.

First and second order septa 27 in number in full growth and more or less pinnately arranged. Counter and alar septa very outstanding, long, thick and extending to near center. In counter quadrants two or three longer septa extending to near center. In premature stage some of them directly united each other. Cardinal septum shorter than other major septa. In counter quadrants septa more accelerated than cardinal ones. Third order septa rarely recognized but very short and almost rudimentary.

In longitudinal section, thin tabulae completely cross entire corallite, rather

* Register number of specimen preserved in the collection of the Institute of Geology and Mineralogy, Faculty of Science, Tokyo University of Education.

coarsely spaced, six in a distance of 10 mm, horizontal in median part, gently uparching or downwards at periphery.

Remarks:—This new subspecies is distinguished from *S. japonicum* (s. s.) by the well developed third order of septa and thicker major septa. It closely resembles *Sochkineophyllum artiense* (Soshkina), but the former possesses a smaller diameter of corallite, almost rudimentary third order septa, and less convex tabulae. It differs from *S. tenuiseptatum* (Soshkina) mainly by the distinct pendant-shape of the protosepta and more crowded tabulae. Also the present form recalls *Plerophyllum hidense* Kamei in many respects, however, his material is unfavorably preserved, thus I withhold comparison with it.

Occurrence and geological age:—The same as the preceding one.

Reg. nos. 20500 (Holotype), 20501 (Paratype).

Family Aulophyllidae Dybowski, 1873

Subfamily Aulophyllinae Dybowski, 1873

Genus *Amandophyllum* Heritsch, 1941

Amandophyllum sp. indet.

Plate 8, figures 7a, b.

Corallum solitary, corallite small. Diameter of corallite 12 mm to 15 mm in mature stage. External character unobservable. Epitheca almost erroded away during fossilization, thus detailed characters remain unknown.

Septa consists of two orders of major and minor. Major septa 26 in number, extend to central column, thickened by secondary deposits, and almost straight. Minor septa alternate with the former, short, about 1/3 as long as major ones and restricted in peripheral region. Central column occupies rather wide well circumscribed area and consists of septal lamellae and axial tabellae, both of which considerably thickend by secondary deposits.

Dissepiments arranged concentrically but partially herringbone pattern.

Remarks:—Only one fragmentary specimen was obtained and its detailed characters are unobservable. Although it is evident that the present specimen is close to the genus *Amandophyllum* Heritsch and resembles *A. carnicum* (Heritsch) in some respects, its naming is reserved until better materials accumulate.

Occurrence:—Conglomeratic shale of the Mizuyagadani formation at the junction of the Takadani and Osobudani Valleys.

Geological age:—Early Permian; Zone of *Pseudoschwagerina*.

Reg. no. 20230.

Family Lonsdaleiidae Chapman, 1893

Subfamily Waagenophyllinae Wang, 1950

Genus *Iranophyllum* Douglas, 1936

Iranophyllum tunicatum Igô, n. sp.

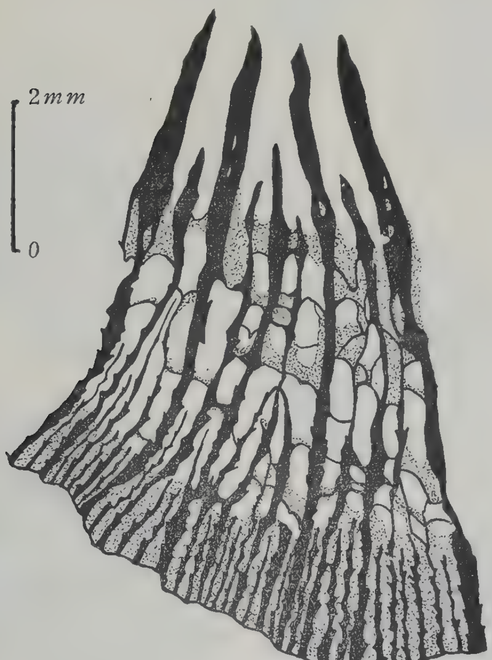
Plate 8, figures 1a, b; text-figure 1.

Corallum solitary, corallite cylindrical and moderate in size. External characters unobservable. Epitheca very thin. Diameter of corallite 20 to 17 mm at maturity.

Septa numerous, those of first order 30 in number, long, extending to near center but not united with columella, strongly thickened by stereoplasmic deposits in intrathecal region, partially diverging, thin in proximal part. Second order septa more numerous but shorter than those of first order, more than 1/3 as long as the former and coalesced

with each other in intrathecal region. Third order septa shorter and restricted in periphery, fewer than those of second order, and about 1/2 length of the latter. Fourth order septa very short, equal in lengh, and restricted to very narrow marginal area. All septa carinated and somewhat zig-zag in dissepimental area. Columella occupies about 1/5 the diameter of corallite, consists of median plate, radiating septal lamellae, and steeply arched axial tabellae. Dissepimental area wide and arranged concentrically.

In longitudinal section dissepiments rather irregular in size and their convex sides faced upwards and inwards.



Text-figure 1.

Remarks:—Iranophyllum tunicatum Igô, n. sp. resembles *I. splendens* Douglas from the Lower Permian of the Tapileh Valley, Darreh Dazden, Southwest Iran (Persia) in many respects. However, the former has well developed fourth order of septa, carinated septa more complicated columella and steeply arched axial tabellae and the septa are more strongly thickened by stereoplasmic deposits in the middle and distal parts. It also resembles *I. carcinophylloides* Douglas from the same locality and *I. permicum* Minato from the Sakamotozawa series of the Kitakami Massif, northeastern Japan, but the present form is distinguishable from the latters in the possession of a greater number of orders of septa.

Occurrence:—From the pebbles of the Osobudani conglomerate, the Osobudani Valley, associated with *Pseudofusulina duplithecata* Igô, *P.* spp., *Nankinella kotakiensis* (Fujimoto and Kawada) and *N. kawadai* (Igô).

Geological age:—Late Early Permian; Zone of *Pseudoschwagerina.*

Reg. no. 21015 (Holotype).

Genus *Wentzelella* Grabau, 1932

Wentzelella osobudaniensis Igô, n. sp.

Plate 8, figure 3.

Corallum massive, cerioid; corallites rather large, hexagonal, pentagonal or octagonal in shape at maturity. Diameter of corallite about 7 to 12 mm. External wall originally thin but more or less thickened by stereoplasmic deposits and straight or zig-zag.

First order septa long, 20 to 24 in number, reach to near center but not jointed with columella, but in young stage one septum (counter?) is jointed with median plate, gradually thickened intrathecal area and thining towards distaly, second order septa about 1/2 to 3/4 as long as those of the first order and more numerous. Third order septa very short, thickened by stereoplasmic

deposits near wall and restricted to marginal part of corallite. Fourth order septa frequently appear but not throughout, and very short. Columella not large, oval in transverse section, well circumscribed and consists of thick median plate, three to five rows of axial tabellae, and few septal lamellae, and distinct median plate is jointed with one major septum in early stage.

Dissepiments arranged concentrically, in rare cases they form interrupted septa where major ones are discontinuous.

Remarks:—The present new form is closely related to *W. szechuanensis* Huang in many respects, but the Fukuji species has a distinct median plate in the columella. Also it differs from *W. kitakamiensis* Yabe and Minato by the same character and shorter fourth order septa. The Fukuji sepecies is distinguishable from *W. sekii* Minato in possessing quaternary septa and a median plate.

Occurrence:—The same as the preceding species.

Geological age:—Early Middle Permian? or late Early Permian.

Reg. no. 20472 (Holotype).

Genus *Lonsdaleiastraea* Gerth, 1921

Lonsdaleiastraea ? sp.

Plate 8, figure 2.

Corallum massive, corallite cerioid partly thamnasteroid and aphroid, subtetragonal or pentagonal in shape, and about five to eight in diameter.

Major septa 17 to 18 in number, long, reach to near center, some of them continue with columella. Minor septa alternate with major ones, shorter, and about 2/3 to 3/5 length of major, third order septa appear, but thinner, fewer and almost rudimentary. These septa are interrupted by vesicular dissepiments, slightly zig-zag or straight. Columellar structure obscure owing to strong stereoplasmic deposits. Dissepiments about 1/2 as wide as diameter of corallite, and arranged concentrically or partially lonsdaleoids.

Remarks:—The species is referred to *Lonsdaleiastraea* with some reservations. The type species of this genus *L. vinassai* Gerth and other Timor species are entirely devoid of external wall but the present specimens they partially dissap-

Explanation of Plate 8

Figs. 1a, b. *Iranophyllum tunicatum* Igô, n. sp.
a, Transverse section of the holotype; b, longitudinal section of the same specimen; ×3.

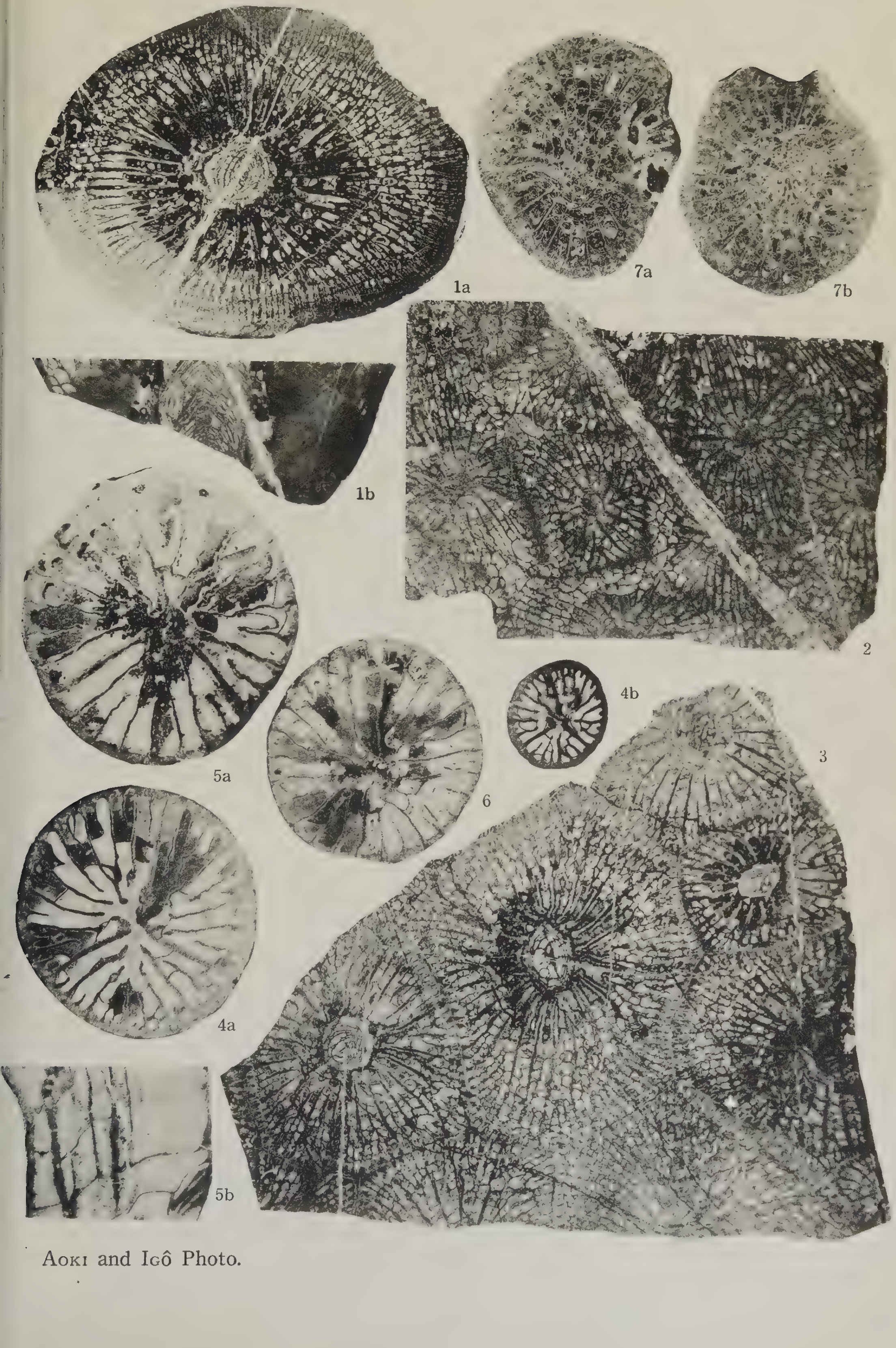
Fig. 2. *Lonsdaleiastraea* ? sp.
Transverse section; ×5.

Fig. 3. *Wentzelella osobudaniensis* Igô,
Transverse section of the holotype; ×3.

Figs. 4a. b. *Sochkineophyllum japonicum* Igô, n. sp.
a, Transverse section in the mature stage of the holotype; ×3; b, transverse section in the immature stage of the same specimen; ×2.5.

Figs. 5a, b, 6. *Sochkineophyllum japonicum pauciseptatum* Igô, n. subsp.
5a, Transverse section in the mature stage of the holotype; 5b, longitudinal section of the same specimen; ×4; 6, transverse section in the mature stage of paratype; ×3.

Figs. 7a, b. *Amandophyllum* sp. indet.
Transverse section in the mature stage; ×3.



AOKI and IGÔ Photo.

pear. Such characters are recognized sometimes in certain species of *Wentzelella*, however, the columella is more related to those of *Lonsdaleiastraea*. Thus the present one has characters of both of these two genera and may be an intermediate form. The present species may be new to science but more specimens are necessary before conclusive decision be given.

Occurrence and geological age:—The same as *Wentzelella osobudaniensis* Igô.

Reg. no. 21014.

References

Douglas, J. A., 1936, A Permo-Carboniferous fauna from Southwest Persia (Iran); *Pal. Indica, N. S., Vol. 22, No. 6*, pp. 1-59, pls. 1-5.

Gerth, H., 1921, Die Anthozoen der Dyas von Timor; *Pal. von Timor, Lief. 9, Abt. 16*, pp. 65-147, pls. 145-150.

Grabau, A. W., 1928, Paleozoic Corals of China: Pt. 1, Tetraseptata; *Pal. Sinica, ser. B, Vol. 2, fasc. 2*, pp. 1-151, pls. 1-8.

Heritsch, F., 1936, Korallen der Moskauer-, Gshel-und Schwagerinen-Stufe der Karnischen Alpen; *Palaeontogr., Bd. 83, Abt. A*, pp. 99-162, pls. 14-18.

Hill, D., 1956, "Rugosa" in Moore's Treatise on Invertebrate Paleontology, Pt. F; *Geol. Soc. America.*

Huang, T. K., 1932, Permian corals of South China; *Pal. Sinica, ser. B, Vol. 8, fasc. 2*, pp. 1-163, pls. 1-16.

Igô, H., 1956a. Notes on the Osobudani conglomerate and some lower Permian fusulinids contained in its limestone Pebbles. Pt. 2; *Sci. Rep., Tokyo Univ. Education, Sec. C, Vol. 4*, pp. 293-302, pls. 18-19.

——, 1956b, Ibid., Pt. 1; *Proc. Trans., Pal. Soc. Japan, N. S., No. 21*, pp. 169-174, pl. 27.

——, 1957, Fusulinids of Fukuji, Southeastern Part of the Hida Massif, Central Japan: *Sci. Rep., Tokyo Univ. Education, Sec, C, Vol. 5, No. 47*, pp. 153-246, pls. 1-15.

Kamei, T., 1957, Two Permian corals from the Mizuyagadani formation; *Jour. Shinshu Univ.*, pp. 29-35, pls. 1-4.

Leed, H., 1956, Permian reef-building corals from North Auckland Peninsula, New Zealand; *Bull., New Zealand Geol. Surv., No. 25*, pp. 15-24, pls. 1-6.

Minato, M., 1955, Japanese Carboniferous and Permian Corals; *Jour. Hokkaido Univ. Inst. Geol. Min., No. 540*, pp. 1-202, pls. 1-43.

Waagen, W. and Wentzel, J., 1886, Salt Range Fossils, Vol. 1, *Productus*-limestone fossils. 6, Coelenterata; *Pal. Indica, ser. 13*, pp. 835-924, pls. 97-116.

Trans. Proc. Palaeont. Soc. Japan, N. S., No. 34, pp. 86-96, pl. 9, June 15, 1959

362. ON THE MIOCENE PECTINIDAE FROM THE ENVIRONS OF SENDAI ; PART 14, ON *PECTEN SWIFTII* BERNARDI*

KÔICHIRÔ MASUDA

Department of Geology, Faculty of Education, Tohoku University

仙台附近中新統産 Pectinidae：その 14, *Pecten swiftii* BERNARDI について：*Pecten swiftii* BERNARDI は寒流系の現生種であるが，化石としてはその最初の産出が中新世前期から知られている。本種は特徴的な形体を持つた種であるが，従来屢々 *Chlamys cosibensis* (YOKOYOMA)，或はその亜種と考えられるものと混同されていた。筆者は，仙台附近及び各地からの化石種及び北日本各地，樺太，朝鮮等からの現生種の標本多数について検討し，記載と比較を行い，その地質学的意義を考察した。

増田孝一郎

Introduction and Acknowledgements

Pecten swiftii BERNARDI (1858), a common Recent scallop in Northern Japan, has been recorded from numerous localities of the Neogene and Pleistocene formations of North Japan. Among the Japanese Miocene Pectinidae this species is interesting because of its long geological range from the Early Miocene and because of its confusing characters.

The fossil *swiftii* in Japan was first described from the "Taga" formation at Hatsuzaki, Hitachi City, Ibaraki Prefecture by KOCHIBE (1882). Subsequently YOKOYAMA described it from the Koshiba formation at Koshiba, Yokohama City, Kanagawa Prefecture in 1920, from the "Taga" formation at Tsurushihama, Hitachi City in 1925, from Obashira, Chichibu City, Saitama Prefecture in 1925 and from the Sawane formation at Sawane, Sawada-machi, Sado-gun, Niigata Prefecture in 1926. NOMURA and HATAI described it from the Daishaka formation at Daishaka, Namioka-machi, Minami-Tsugaru-gun, Aomori Prefecture in 1935 and from the Ôtsutsumi formation at Ôtsutsumi, Taiwa-machi, Kurokawa-gun, Miyagi Prefecture in 1937. However, it is considered that YOKOYAMA's single right valve from Koshiba is a synonym of *Chlamys cosibensis* (YOKOYAMA) which was described from the same locality at an earlier date, and the single right valve from Obashira probably represents a new subspecies of *Chlamys cosibensis* which will be described at another opportunity as *Chlamys cosibensis hanzawae* MASUDA, n. subsp., and the single right valve reported from Ôtsutsumi is *Chlamys cosibensis hanzawae*, though specimens referable to *swiftii* have been collected from the same locality by NOMURA and HATAI. In the present article the reports with illustrations were reviewed but those with only listed occurrences were rejected because the original specimens could not be studied.

Numerous Recent and fossil specimens were studied, and these included those now preserved in the collections of the Department of Geology, Faculty of Education, in the Institute of Geology and Paleontology, Faculty of Science, both

* Received Oct. 14, 1958; read at the 71st. meeting of the Society at Kyoto, Sept. 27, 1958.

of the Tohoku University, and in the Saito Ho-on Kai Museum, all in Sendai City. The results of examination on the Recent and fossil *swiftii* and its geological significance are presented herein.

Acknowledgements are due to Dr. Kotora HATAI of the Department of Geology, Faculty of Education, Tohoku University, for kindly supervising the present work, and also to Mr. Shin-ichi HONMA of the Kanazawa High School at Kanazawa, Sado Island, Niigata Prefecture, for his assistance in collecting specimens.

Description

Family Pectinidae

Subfamily Pectininae

Genus *Chlamys* (BOLTEN) RÖDING, 1798

Subgenus *Swiftopecten* HERTLEIN, 1935

Chlamys (*Swiftopecten*) *swiftii* (BERNARDI), 1858

Plate 9, figures 1-7.

1867. *Pecten swiftii* BERNARDI, SCHRENCK, *Moll. Amurl. Nordjap. Meereas*, p. 487, pl. 21, figs. 1-3.
1882. *Pecten swiftii* BERNARDI, KOCHIBE, *Rika Kai-shi, Tokyo Univ. Press, No. 4*, p. 75, pl. 5, fig. 2.
1888. *Pecten swiftii* BERNARDI, KÜSTER und KOBELT in MARTINI und CHEMNITZ, *Syst. Conch. Cab., Vol. 7, Pt. 2*, p. 142, pl. 40, fig. 3.
1902. *Pecten swiftii* BERN., YÓSHIWARA, *Zool. Mag. Tokyo, Vol. 14, No. 162*, p. 144, pl. 2, figs. 6a-b.
1925. *Pecten swiftii* BERNARDI, YOKOYAMA, *Jour. Coll. Sci., Imp. Univ. Tokyo, Vol. 45, Art. 5*, p. 27, pl. 2, fig. 1.
1926. *Pecten swiftii* BERNARDI, YOKOYAMA, *Jour. Fac. Sci., Imp. Univ. Tokyo, Vol. 1, Pt. 8*, p. 303, pl. 37, figs. 5, 6.
1931. *Pecten* (*Pallium*) *swiftii* BERNARDI, GRANT and GALE, *Mem. San Diego Soc. Nat. Hist., Vol. 1*, p. 171, pl. 10, figs. 1a-b, 4a-b.
1934. *Chlamys swiftii* (BERNARDI), KINOSHITA and ISAHAYA, *Rep. Fish. Surv., Hokkaido Fish. Exp. Sta., No. 33*, p. 14. pl. 10, fig. 74.
1935. *Pecten* (*Pallium*) *swiftii* BERNARDI, NOMURA and HATAI, *Saito Ho-on Kai Mus., Res. Bull., No. 6*, p. 98, pl. 9, fig. 8, pl. 10, figs. 3, 4, pl. 11, fig. 8, pl. 13, fig. 3.
1950. *Chlamys islandicus* var. *swiftii* (BERNARDI), KUBOTA, *Shinseidai-no-Kenkyu* (*Cenozoic Research*), *No. 6*, p. 12, pl. 9, figs. 66, 67.
1951. *Chlamys swiftii* (BERNARDI), TAKI in HIRASE, *Illust. Handb. Shells Nat. Color, Japan. Adj. Territ.*, pl. 12, fig. 5.
1951. *Chlamys swiftii* (BERNERDI), HABE, *Genera Japan. Shells, No. 1*, p. 74, fig. 150.
1955. *Chlamys swiftii* (BERNARDI), HABE, *Publ. Akkeshi Mar. Biol. Stat., No. 4*, p. 6, pl. 2, fig. 7.
1955. *Chlamys swiftii* (BERNARDI), KIRA, *Color. Illust. Shells Japan*, p. 99, pl. 49, fig. 14.
1958. *Chlamys* (*Swiftopecten*) *swifti* (BERNARDI), HABE, *Publ. Seto Mar. Biol. Lab., Vol. 6, No. 3*, p. 263, pl. 12, fig. 18.

Shell large and thick, much higher than long, moderately inflated, inequilateral, posterior side longer than anterior, postero-dorsal side nearly straight and antero-dorsal side gently curved, ventral margin uneven corresponding to external sculpture; left valve somewhat more convex than right; both valves radiately ribbed and forming an angle of about 70° at apex.

Right valve with four, rather prominent, round-topped radial ribs, two subordinate radial ribs near submargins, intercalary threads and concentric growth lines, and ornamented by rather distinct fine network; radial ribs broader than their interspaces, gently bend anteriorly towards ventral margin, sculp-

tured with several, nearly equal, fine radial threads which are separated by shallow and narrow longitudinal furrows and usually bifurcate towards ventral margin, but sometimes backs of radial ribs rather smooth; two subordinate radial ribs near submargins separated from main radial ribs by shallow and narrow interspaces, usually slender and obsolete, and sculptured with a few, faint, fine radial threads; four to six intercalary threads between radial ribs sometimes bifurcate near ventral margin, and nearly equal to radial threads of backs of radial ribs in strength at ventral margin; primary intercalary threads two or three near beak, increase their number towards ventral margin; submargins sculptured with numerous, faint, fine unequal radial threads which are fainter and finer than those of central part of disc; concentric constrictions rather distinct; sculpture of backs of radial ribs usually more distinct at ventral margin and concentric plait than those of other places; anterior auricle very large, nearly triangular in shape, much larger and longer than posterior one, furnished with rather deep and wide byssal notch, rather narrow byssal area, and sculptured with several, more or less elevated, distinct radial threads, somewhat less distinct intercalary threads and concentric lines; posterior auricle similar to anterior in sculpture, though radial threads less distinct than those of anterior; hinge with rather simple cardinal crura, rather distinct ctenolium, and deep and wide resilial pit provided with elevated, distinct lateral ridges; hinge plate rather flat and wide, and sculptured with fine, faint striae parallel to hinge line in adult specimen. Left valve with five, prominent, round-topped, rather smooth radial ribs, fine intercalary threads and concentric growth lines, and ornamented by rather distinct fine network; radial ribs narrower than their interspaces, and sculptured with several, rather faint, fine radial threads which are nearly equal to their interspaces and rarely divided into two parts by a shallow longitudinal furrow near ventral margin; intercalary threads seven to ten, narrower than their interspaces on upper half of disc but nearly equal at ventral margin, and rarely divided into two parts by a shallow longitudinal furrow near ventral margin; primary intercalary threads three to four near beak and increase their number towards ventral margin; concentric constrictions usually conspicuous, by which radial ribs appear nodose; anterior auricle triangular in shape, and sculptured with several, distinct, elevated radial threads, somewhat less distinct intercalary threads and rather distinct concentric lines, by which radial threads appear somewhat nodose; posterior auricle similar to anterior in sculpture, though radial threads much less distinct than those of anterior. Interior surface of both valves distinctly or gently folded corresponding to external sculpture and with fine serration at ventral margin.

Dimensions:—Shown in Table 1.

Comparison and Affinity:—*Chlamys* (*Swiftopecten*) *parmeleei* reported by DALL (1898) from the Pliocene of California and *Chlamys* (*Swiftopecten*) *kindlei* described by DALL (1920) from the Pliocene of Alaska are closely related to the present species, but as pointed out by DALL (1920), the former differs from the present one in having a smaller shell and peculiar microscopic squamation, and the latter by the lacking of concentric waves due to the resting stages. The present species also resembles *Chlamys wattsi* and *Chlamys wattsi*

Table 1. Measurements on the selected specimens of *swiftii* (in mm.)

Locality	Height	Length	Hinge-length	Depth	Apical angle	Valve	Locality	Height	Length	Hinge-length	Depth	Apical angle	Valve
A	131	110	55	20.5	75°	R	C	36	27.5	17	4.8	70°	L
〃	115	97	—	24	70°	R	〃	35	30	—	6.7	70°	L
〃	111.5	98	49.5	20.5	70°	R	〃	34	29	18.5	7	70°	L
〃	100.5	87.5	—	21.5	70°	R	D	—	84.5	—	15	70°	R
〃	79	68	34	14	70°	R	E	92	—	45	29	70°	L
〃	39	29.5	17	6.8	70°	R	F	96	79	43.5	18.5	70°	R
〃	35	29.5	16	6.5	70°	R	G	103	86	50	21.5	70°	R+
〃	35	28	—	7	70°	L	〃	103	86	50	25.5	70°	L+
B	68.5	53.5	—	11.2	70°	R	H	89	75	42.5	14.3	70°	R+
〃	57.5	47.8	25	11	70°	R	〃	89	75	42.5	19	70°	L+
〃	57	43	26.5	10.7	70°	R	〃	88	76	41.5	14	70°	R+
〃	53.5	44	28	10.5	70°	R	〃	88	76	41.5	17	70°	L+
〃	26.6	21.4	—	4.2	70°	R	〃	75.5	63	34	10.9	70°	R
〃	99	81	—	23.5	70°	L	〃	88.5	69	43	18.2	70°	L
〃	96.8	81	39	23	70°	L	I	101	88	58	21	70°	R+
〃	50	40	—	8.5	70°	L	〃	101	88	58	25.5	70°	L+
C	91.5	80.5	42	18	70°	R	J	89	75	46	14.7	70°	R+
〃	91	76	41	22	70°	R	〃	89	75	46	20.5	70°	L+
〃	81	65	33.5	15	70°	R	K	111	94.5	48	25	70°	R
〃	76	70.5	34	15.5	70°	R	〃	105	91.7	48	24	70°	R
〃	76	63	34	15.5	70°	R	〃	103	93	52.5	23	70°	R+
〃	30	24	16	6	70°	R	〃	103	93	52.5	28	70°	L+
〃	17.5	14.7	—	2.8	70°	R	〃	102	88	—	27.5	70°	L
〃	63	52	—	17	70°	L	L	120	101	50	20	70°	R
〃	40	33	18	7.5	70°	L	〃	119	100.5	59.5	28.5	70°	L
〃	36	29.5	—	6	75°	L	〃	100	88	52	26	70°	L

+ : Intact valves, A : Daishaka, Namioka-machi, Minami-Tsugaru-gun, Aomori Pref. (Pliocene). B : Sawane, Sado Island, Niigata Pref. (Pliocene). C : Tayazawa, Wakimoto, Oga City, Akita Pref. (Pliocene). D : Chikagawa, Tanabu-machi, Shimokita-gun, Aomori Pref. (Pliocene). E : Pirika, Imagane-machi, Setana-gun, Hokkaido (Pliocene). F : Madate, Toda-mura, Ichihara-gun, Chiba Pref. (Pleistocene). G : Manui, east coast of Southern Saghalien (Recent). H : Dui-March, Northern Saghalien (Recent). I : Shizugawa, Motoyoshi-gun, Miyagi Pref. (Recent). J : Kesen-numa, Miyagi Pref. (Recent). K : Mutsu Bay, Aomori Pref. (Recent). L : Shimpo, Kankyo-Nando, Korea (Recent).

var. *morani* which were described from the Pliocene of California by ARNOLD (1906), but it can be distinguished from the former by its posteriorly contorted shell, smaller number of intercalary threads, shape of auricle and rather large posterior auricle, and from the latter by the above mentioned characters and rather less distinct radial threads on the backs of radial ribs and in their interspaces than those of the present one. From *Chlamys etchegoini* which was described by ANDERSON (1905) from the Pliocene of California, it is distinguishable by its smaller shell and the characters of the radial ribs. This species much resembles *Chlamys cosibensis* which was described by YOKOYAMA (1911) from the Pliocene Koshiba formation, but it can be distinguished from *cosibensis* by its large, posteriorly contorted shell which is much higher than long, smaller apical angle, triangular anterior auricle, hinge with rather simple cardinal crura and nearly flat left valve in the young shell. *Chlamys kitamurai* which was described by KOTAKA (1955) from the Oligocene Isomatsu formation, Aomori Prefecture, is distinguishable from the present one in the greater number of and the different mode of bifurcation of the radial ribs and intercalary threads.

Remarks:—This species is characterized by its large and thick, posteriorly contorted shell which forms an angle of about 70° at apex and is much higher than long, four, rather prominent round-topped radial ribs which are sculptured with several, fine radial threads, two subordinate radial ribs near submargins, fine intercalary threads, rather conspicuous concentric constrictions, very large triangular anterior auricle, and flat hinge plate which is sculptured with faint, fine striae parallel to the hinge line in the right valve. The left valve is characterized by its five (rarely four or six) conspicuously prominent, round-topped radial ribs which are usually nodose and by its young shell which is nearly flat or rarely a little concave upwards. As pointed by YOKOYAMA (1926) and NOMURA and HATAI (1935), the radial ribs sometimes become strong and elevated but may be low and flattened. Sometimes the sculptures of radial ribs are obscure, especially in the case of the conspicuously nodosed radial ribs of the left valve.

Some differences between the fossil and Recent specimens are observed. In the Miocene specimens the radial threads on the backs of radial ribs and in their interspaces of both valves are usually more numerous and more close-set than those from the Pliocene, Pleistocene and Recent, and the fossil left valve is usually nearly flat or rarely more or less concaved upwards in the young stage, while the Recent shells are gently inflated and tend to gradually increase their convexity towards the ventral margin, and moreover, the concentric constrictions are rather less conspicuous than those of the fossil shells, but the characteristics except for the above mentioned are quite similar to each other. In other words, the variability of the left valve is more progressional or responds more to the environmental conditions than the right valve (MASUDA, 1957).

Described specimens:—Right stream cliff, northwest of Daishaka, Namioka-machi, Minami-Tsugaru-gun, Aomori Prefecture. Conglomeratic, calcareous coarse-grained sandstone of the Daishaka formation (Pliocene). DGS, Reg. No. 3684.

Occurrence;—Ôtsutsumi formation in Miyagi Prefecture and Ginzan formation in Yamagata Prefecture: Late Early

Miocene.

"Taga" formation in Ibaraki Prefecture and Suenomatsuyama formation in Iwate Prefecture: Late Miocene.

Sawane and Shiraiwa formations in Niigata Prefecture, Sasaoka and Shibikawa formations in Akita Prefecture, Daishaka and Hamada formations in Aomori Prefecture, and Kami-iso and Setana formations in Hokkaido: Pliocene.

Narita formation in Chiba Prefecture, and Shishinai and Kushiro formations in Hokkaido; Pleistocene (text-fig. 1).

Geographical Distribution:—Northern Honshû, Hokkaido, Kurile Islands, Saghalien, West Coast of Amurland, Tartary Strait, Northeastern Korea, Korea Strait and off Alaska.

Geological range:—Late Early Miocene to Recent.

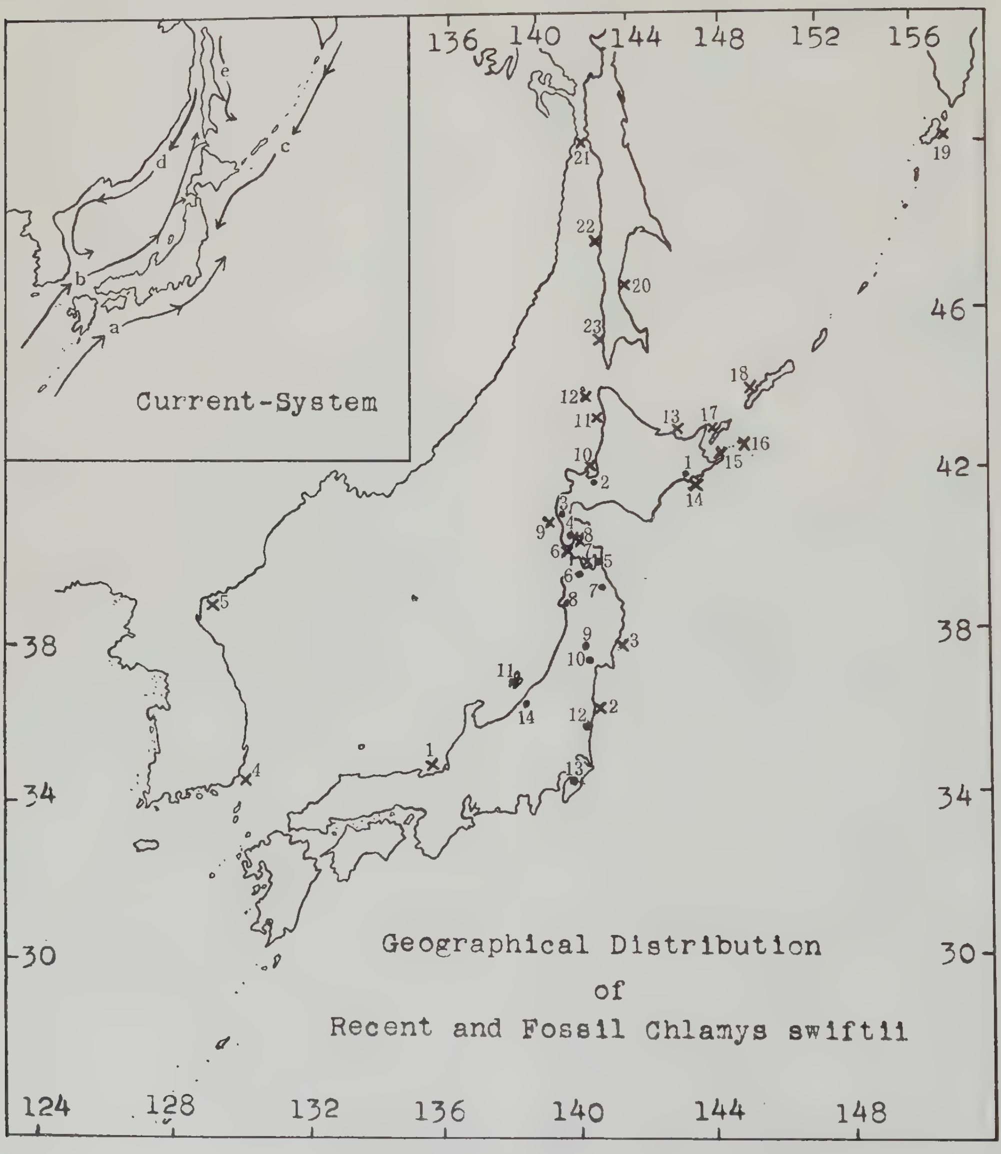
Remarks on the Recent *swiftii*

The Recent *swiftii* has a wide geographical distribution extending Northern Honshû to as far south as Fukushima Prefecture along the Pacific and to as far south as Fukui Prefecture along the Japan Sea, northwards to Hokkaido, Kurile Islands, Saghalien, westwards to the Korea Strait, northeastern coast of Korea and the west coast of Amurland (text-fig. 1), and it is also stated to be living off Alaska. The area of distribution in the Pacific is influenced by the Oyashio Cold Current, in the Japan Sea by the Liman Stream (Northern Korea Cold Current) and in the Okhotsk Sea by the Eastern Saghalien Cold Current (text-fig. 1). However, sometimes this species lives in areas influenced by the warm current as Mutsu Bay, Tsugaru Strait, Wakasa Bay and the Korea Strait. These areas are influenced annually or seasonally by the cold current. Therefore, it is evident that *swiftii* is a cold water inhabitant, though it is more or less eurythermal, and *swiftii* seems to prefer a rather shallow clean sea bottom of rock or gravels.

Some morphological differences are observed between the specimens from Saghalien and those from Northern Honshû. The concentric constrictions of the left valve from Saghalien are somewhat less developed than those from Northern Honshû, so that, the radial ribs of the former are usually rather low and flattened and the convexity of the former is somewhat less than that of the latter, but the variability of the right valve is rather less than that of the left valve. Although the number of examined specimens are not abundant, the mentioned facts suggest that the specimens living in northern regions are somewhat less influenced by the variation in the annual water temperature than those living in more southern areas, owing to the smaller thermal range of the annual water temperature compared with that of the southern area. For instance, according to Ekman (1953) the water on the continental part of the Japan Sea, in the southern part of the Okhotsk Sea and the northern islands of the Kurile group, is characterized by an arctic temperature during the whole year at the depth below 25 to 30 m. And the surface water temperature in the Northern Kurile Islands is 7°C in August and −1°C in February, while that of the southwest coast of Hokkaido is 15°C to 18°C in August and less than 0°C in February. Concerning such case Nomura and Hatai (1936) have discussed on the living *Neptunea arthritica* Bernardi. The above mentioned data may aid to analyse the environmental conditions of the fossil *swiftii*, but further data are necessary to settle this problem.

Geological Significance

As known at present, the oldest occurrence of *swiftii* is from the Ôtsutsumi and Ginzan formations in Northeastern Honshû, Japan, where it is rather rare. The next occurrence of *swiftii* is the Late Miocene Suenomatsuyama and "Taga" formations, where it is associated with several rather cold water species. Abundant specimens of *swiftii* occur from the Pliocene Sawane, Shiraiwa, Sasaoka, Hamada, Daishaka, Kami-iso and Setana formations in association with many



Text-figure 1.

boreal molluscan shells as *Patinopecten yessoensis* (JAY), *Pododesmus macroschisma* (DESHAYES), *Astarte alaskensis* DALL, *Conchocele disjuncta* GABB, *Clinocardium ciliatum* (FABRICIUS), *Neptunea lirata* (GMELIN), etc., boreal forms of Bryozoa (KATAOKA, 1957) and foraminifers. *Swiftii* is also known from the Pleistocene Narita formation in Chiba Prefecture and from Shishinai and Kushiro formations in Hokkaido.

From the morphological difference between the Recent and fossil specimens which is but little, it is inferred that the present species acquired its *stasigenesis* during the late Early Miocene, and survived to the present with little morphological variation. This view is upheld from the gradual increase in the individual number of *swiftii* in good agreement with the increase of the associated boreal fauna such as molluscs, bryozoans and foraminifers from the late Early Miocene through the Pliocene to the Recent.

Chlamys nutteri (ARNOLD) and *Chlamys* (*Swiftopecten*) *kindlei* (DALL) were regarded as the varieties of *swiftii* by GRANT and GALE (1931) and *Chlamys wattsi* (ARNOLD), *Chlamys wattsi* var. *morani* (ARNOLD), *Chlamys cosibensis* (YOKOYAMA) and "*Pecten tiggerinus*" YOKOYAMA (not of MÜLLER) also included into *Chlamys swiftii* var. *etchegoini* (ANDERSON) by the same authors. Moreover, they considered that *Chlamys heteroglypta* (YOKOYAMA) which was described from the Pliocene Sawane formation is a synonym of *Chlamys swiftii* var. *nutteri* (ARNOLD), and that *Chlamys* (*Swiftopecten*) *parmeleei* (DALL) is one of into *swiftii*. Subsequently, NOMURA and HATAI (1935) considered that YOKOYAMA's species and *Chlamys nutteri* should be held as distinct species. The writer agrees with GRANT and GALE in regarding *kindlei* as a subspecies of *swiftii* and with NOMURA and HATAI in holding the Japanese species and *Chlamys nutteri* as distinct from one another, but the writer is inclined to consider *parmeleei* as a subspecies of *swiftii*. It is inferred that *Chlamys* (*Swiftopecten*) *swiftii kindlei* and *Chlamys* (*Swiftopecten*) *swiftii parmeleei* are descended from *swiftii* (s. s.) as a result of its eastward migration from Japan to the western coast of America followed by localization and adaptation, and that both subspecies became extinct

Explanation of Text-figure 1.

Current-System:

a: Kuroshio Warm Current. b: Tsushima Warm Current. c: Oyashio Cold Current. d: Liman Stream (North Korean Cold Current). e: Eastern Saghalien Cold Current.

Distribution Map:

● .... Fossil locality:

1: Kushiro (Pleistocene). 2: Shishinai (Pleistocene). 3: Setana (Pliocene). 4: Kami-iso (Pliocene). 5: Hamada (Pliocene). 6: Daishaka (Pliocene). 7: Suenomatsuyama (Miocene). 8: Sasaoka and Shibikawa (Pliocene). 9: Ginzan (Miocene). 10: Ôtsutsumi (Miocene). 11: Sawane (Pliocene). 12: Taga (Miocene). 13: Madachi (Pleistocene). 14: Shiraiwa (Pliocene).

× .... Recent locality:

1: Wakasa Bay. 2: Onahama. 3: Kesen-numa and Shizugawa. 4: Korea Strait. 5: Shimpo. 6: Tsugaru Strait. 7: Mutsu Bay. 8: Hakodate. 9: Okujiri and Kumaishi. 10: Otaru Bay. 11: Teshio. 12: Rishiri. 13: Kitami. 14: Kushiro and Akkeshi. 15: Nemuro and Hanasaki. 16: Shakotan. 17: Kunashiri. 18: Yetorup. 19: Paramushir. 20: Manui. 21: Tartary Strait. 22: Esutoru. 23: Honto.

before the end of the Pliocene. However, to settle this problem the fossil specimens of *swiftii* and its related forms from California and Alaska should be studied comparatively and more Recent specimens from the northern Pacific must be examined.

References

ARNOLD, R. (1906), The Tertiary and Quaternary Pectens of California. *Prof. Paper, U.S. Geol. Surv., No. 47,* pp. 7-146, 53 pls.

DALL, W.H. (1898), Contributions to the Tertiary Fauna of Florida, with especial Reference to the Miocene Silex Beds of Tampa and the Pliocene Beds of Caloosahatchie River. *Trans. Wagner Free Inst. Sci., Vol. 3, Pt. 4,* pp. 571-947, 12 pls.

—— (1920), Pliocene and Pleistocene Fossils from the Arctic Coast of Alaska and the Auriferous Beaches of Nome, Norton Sound, Alaska. *Prof, Paper, U.S. Geol. Surv., No. 125-C,* pp. 23-34, 2 pls.

DUNKER, W. (1882), Index Molluscorum Maris Japonici. pp. 1-301, 16 pls.

EKMAN, S. (1953), Zoogeography of the Sea. pp. 1-404, *Sidgwick and Jackson, Ltd.,* London.

GRANT, U.S. and H.R. GALE (1931), Catalogue of the Marine Pliocene and Pleistocene Mollusca of California and Adjacent Regions. *Mem. San Diego Soc. Nat. Hist., Vol. 1,* pp. 7-1036, 32 pls.

HABE, T. (1951), Genera of Japanese Shells. Pelecypoda No. 1, pp. 7-96, figs. 1-192.

—— (1955), Fauna of Akkeshi Bay, 21, Pelecypoda and Scaphopoda. *Publ. Akkeshi Mar. Biol. Stat., No. 4,* pp. 1-31, 7 pls.

—— (1958), Report on the Mollusca chiefly collected by the S.S. Sôyo-maru of the Imperial Fisheries Experimental Station on the Continental Shelf bordering Japan during the Years 1922-1930. Part 3. Lamellibranchia (I). *Publ. Seto, Mar. Biol. Lab., Vol. 6, No. 3,* pp. 241-279, 3 pls.

HANZAWA, S. (1950), Tertiary Paleogeography of North Japan. *Short Papers, Inst. Geol. Paleont. Tohoku Univ., No. 2,* pp. 74-98.

HATAI, K. (1936), A Note on the Distribution of Certain Species of Marine Invertebrates. *Bull. Biogeogr. Soc. Japan, Vol. 6, No. 12,* pp. 123-141.

—— and S. NISIYAMA (1939), Palaeontological Notes on Certain Japanese Scallops. *Jour. Geol. Soc. Japan, Vol. 46, No. 544,* pp. 37-46, 3 text-figs.

—— (1939), Migration of Marine Fauna in the North Pacific Area during the Younger Cenozoic Era. *Proc. Sixth Pacific Sci. Congr.,* pp. 479-482.

—— (1950), Cenozoic Mollusca from Aomori Prefecture, Japan. *Jour. Conch., Vol. 90,* pp. 128-136.

HERTLEIN, L.G. (1935), The Templeton Crocker Expedition of the California Academy of Sciences, 1932. *Proc. Calif. Acad. Sci., Ser. 4. Vol. 21, No. 25,* pp. 301-324, 2 pls.

—— (1936), Three New Sections and Retifications of Some Specific Names in the Pectinidae. *Nautilus, Vol. 40, Nos. 1-2,* pp. 1-8.

KANEHARA, K. (1942), Fossil Mollusca from Tayazawa, Wakimoto-mura, Katanisi Oil Field. *Jour. Geol. Soc. Japan, Vol. 49, No. 581,* pp. 130-133, 1 pl.

KATAOKA, J. (1957), Bryozoa from the Daishaka Formation (Pliocene), Minami-Tsugaru-gun, Aomori Prefecture. *Trans. Proc. Palaeont. Soc. Japan, N.S., No. 28,* pp. 143-153, 1 pl.

KINOSHITA, T. and T. ISAHAYA (1934), Catalogue of Marine Mollusca from Hokkaido. *Rep. Fish. Surv., Hokkaido Fich. Exp. Stat., No. 33,* pp. 1-19, 15 pls.

KOCHIBE, T. (1882), Jôhoku Chishitsu Hen (Geology of Northern Hitachi). *Rika Kai-shi, Tokyo Univ. press, No. 4,* pp. 1-153, 9 pls.

KOTAKA, T. (1955), Molluscan Fauna from the Oligocene Isomatsu Formation, Aomori Prefecture, Northeast Japan. *Saito Ho-on Kai Mus., Res. Bull., No. 24,* pp. 23-30, 1 pl.

KUBOTA, K. (1950), Explanation of Cenozoic Fossils from Northern Japan, 9, Fossil Pectinidae from the Setana Series. *Shin-*

seidai-no-Kenkyu (*Cenozoic Research*), *No. 6*, pp. 12-18, 2 pls.

KURODA, T. (1929-1935), An Illustrated Catalogue of Japanese Shells. Parts. 1-16. *Venus, Vols. 1-5, Append.* pp. 1-154.

—— and K. KOBA (1933), Molluscan Fauna of the Northern Kurile Islands. *Bull. Biogeogr. Soc. Japan, Vol. 4, No. 2*, pp. 151-170, 1 pl.

KÜSTER, H. C. und W. KOBELT in MARTINI und CHEMNITZ (1888), Die Gattungen *Spondylus* und *Pecten. Syst. Conch. Cab., Vol. 7, Pt. 2*, pp. 1-296, 72 pls.

MASUDA, K. (1957), A Note on *Miyagipecten matsumoriensis* MASUDA. *Saito Ho-on Kai Mus., Res. Bull., No. 26*, pp. 31-39, 1 pl.

NIINO, H. (1934), On the Soundings from the Bottom of the Western Part of the Tsugaru Strait. *Jour. Geol. Soc. Japan, Vol. 41, No. 495*, pp. 713-726.

—— (1949), On the Bottom Deposits on the Banks at Mouth of Wakasa Bay and on the Adjacent Continental Shelf. *Japan. Jour. Geol. Geogr., Vol. 21, Nos. 1-4*, pp. 193-225, 2 pls.

NOMLAND, J. O. (1917), The Etchegoin Pliocene of Middle California. *Univ. Calif. Publ. Geol., Vol. 10*, pp. 191-240, 7 pls.

NOMURA, S. and N. HATAE (1928), Outlines of the Distribution of Some Recent Mollusca on the Coast of Korea. *Jour. Nat. Hist. Chosen, No. 6*, pp. 1-9.

—— and H. TSUNODA (1933), Recent Mollusca from Onahama Bay, Hukushima Prefecture. *Saito Ho-on Kai Mus., Notes, Vol. 3*, pp. 1-19.

—— and K. HATAI (1935), Pliocene Mollusca from the Daishaka Shell Beds in the Vicinity of Daisyaka, Aomori-ken, Northeast Honsyû, Japan. *Saito Ho-on Kai Mus., Res. Bull., No 6*, pp. 83-137, 5 pls.

—— and —— (1936), A Note Concerning Data on the Bathymetric Range of Certain Marine Animals and Remarks on the Geology of the Neogene Formation in Northeast Honsyû, Japan and their Depth of Sedimentation as indicated by the Fossil Fauna. *Ibid., No. 10*, pp. 231-334.

—— and —— (1937), A List of the Miocene Mollusca and Brachiopoda Collected from the Region lying North of the Nanakita River, in the Vicinity of Sendai, Rikuzen Province, Japan. *Ibid., No. 13*, pp. 121-145, 5 pls.

—— and —— (1937), On the Variation of *Neptunea arthritica* BERNARDI, from the Northern and Central Honsyû, Japan. *Ibid., No. 13*, pp. 1-5, 2 pls.

—— and —— (1938), On Some Fossils from Akita Prefecture, Northeast Honsyû, Japan. *Japan. Jour. Geol. Geogr., Vol. 16, Nos. 1-2*, pp. 39-64, 5 text-figs.

OINOMIKADO, T. (1937), Molluscan Fossils from the Pleistocene Deposit of Sisinai in Tobetu-mura, Isikari-gun, Hokkaido. *Jour. Geol. Soc. Japan, Vol. 44, No. 520*, pp. 65-70.

OYAMA, K. (1951), On Mollusca dredged from off Kumaisi with Notes on Rise and Fall of Ocean-current. *Misc. Rep. Res. Inst. Nat. Res., Nos. 19-20*, pp. 137-141.

—— (1952), Palaeontological studies on Pectens. *Ibid., No. 25*, pp. 24-30.

SASA, Y. (1939), On the Kusiro Series, the lower Pleistocene Deposits in Eastern Hokkaido, Japan. *Jub. Publ. Comm. Prof. H. Yabe's 60th Birthday, Vol. 1*, pp. 569-587.

SCHRENCK, L. (1867), Mollusken des Amur-Landes und des Nordjapanischen Meeres. *Reisen und Forschung Amurlande in dem 1854-1856. Vol. 2, Pt. 3*, pp. 259-976, 17 pls.

SUGAI, K., H. MATSUI, S. SATO, Y. KITAKAWA, M. SASAKI, M. MIYASHITA and H. KAWACHI (1957), Explanatory Text of the Joban Coal Field. Geological Maps of the Coal Fields of Japan, I. *Geol. Surv. Japan*, pp. 1-143, 58 text-figs., 3 maps.

YOKOYAMA, M. (1920), Fossils from the Miura Peninsula and its Immediate North. *Jour. Coll. Sci., Imp. Univ. Tokyo, Vol. 39, Art. 6*, pp. 1-193, 20 pls.

—— (1925), Molluscan Remains from the Uppermost Part of the Jo-ban Coal Field. *Ibid., Vol. 45, Art. 5*, pp. 1-34, 6 pls.

—— (1926), Fossil Shells from Sado. *Ibid., Vol. 1, Pt. 8*, pp. 249-312, 6 pls.

YOSHIWARA, S. (1902), Japanese Shells (Lamellibranchs). *Zool. Mag. Tokyo, Vol. 14, No. 168*, pp. 141-145, 5 pls.

Explanation of Plate 9

Chlamys (*Swiftopecten*) *swiftii* (BERNARDI)

Fig. 1. Left valve, ×1. SM. Reg. No. 4527. Loc. Ôtsutsumi, Taiwa-machi, Kurokawa-gun, Miyagi Prefecture. Ôtsutsumi formation.

Figs. 2, 3. Left valve, ×1. SM. Reg. No. 16827. Loc. Tominaga, Wakimoto-machi, Oga City, Akita Prefecture. Shibikawa formation.

Figs. 4, 5. Right valve, ×1. SM. Reg. No. 21266. Loc. Tayazawa, Wakimoto-machi, Oga City, Akita Prefecture. Shibikawa formation.

Figs. 6a–b. a, Right valve, ×2/3. b, Hinge area of Fig. 6a, ×1. DGS, Reg. No. 3684. Loc. Right stream cliff, northwest of Daishaka, Namioka-machi, Minami-Tsugaru-gun, Aomori Prefecture. Daishaka formation.

Fig. 7. Left valve, ×ca. 1. DGS, Reg. No. 3699. Loc. Kaidate-no-sawa, Sawada-machi, Sado-gun, Niigata Prefecture. Sawane formation.

MASUDA photo.

Trans. Proc. Palaeont. Soc. Japan, N. S., No. 34, pp. 97-104, June 15, 1959

363. *TRIGONIOIDES* AND ITS CLASSIFICATION

(Studies on the Molluscan Fauna of the Cretaceous Inkstone Series. Part 2)*

YOSHIHISA OTA

Fukuoka Liberal Arts College

Trigonioides 及びその分類：脇野層上部，御所浦層上部，新羅統並に Laos の標本を基にして，*Trigonioides* を再検討し，一新亜種を記載した．また，従来の分類を検討し，新しい分類を示した．

太 田 喜 久

I Introduction

Trigonioides KOBAYASHI and SUZUKI (1936) is an important genus in the non-marine Cretaceous fauna of Eastern Asia. They expressed an interesting opinion that its peculiarities are due to adaptation of trigoniid to a new non-marine environment which was produced by the Sakawa orogeny. Subsequently it was discovered from various districts on the continental side of Eastern Asia. Especially important is MATSUMOTO's discovery of shallow sublittoral marine beds from the upper Gosyonoura group in which *Trigonioides* bearing brackish or fresh water sediment is intercalated. Now seven species are known of the genus. Previously its classification was made chiefly by its outline and ornament but a careful comparison among numerous specimens has shown that variation in outline and ornaments is fairly wide even among the shells from one locality. Seven species including one new subspecies are here recognized by a new standpoint and their phylogenetic relationship is discussed.

The writer expresses his sincere thanks to Prof. T. KOBAYASHI of the University of Tokyo for kind guidance and reading manuscript, to Prof. T. MATSUMOTO of the Kyusyu University and Dr. K. SUZUKI of the Research Institute for Natural Resources for encouragement.

II Historical review

1. KOBAYASHI and SUZUKI (1936) erected the genus in describing *T. kodairai* from the Lower Cretaceous Naktong series (Suimondo beds) of S. Korea and Wakino series (Rikimaru beds) of N. Kyusyu, Japan. From the hinge nature it was referred to the Trigoniidae. Its principal speciality in surface marking was considered to depend on the change of the habitat from marine to fresh water.

2. HOFFET (1937) described four new species of *Trigonioides* (*kobayashi*, *laotiae*, *trigonus* and *diversicostatus*) from the Senonian of Laos and arrived at the conclusion that *Trigonioides* is a trigonoid shell distinguishable from *Trigonia* in hinge teeth and surface ornament.

3. MATSUMOTO (1938) described *T. kobayashii* from the upper Gosyonoura group and pointed out the difference between *Trigonioides* and *Trigonia* beside the diagnostic shell features.

* Received July 28, 1958; read Feb. 14, 1959, at Hiroshima University.

4. KOBAYASHI and SUZUKI (1940) proposed a new name *T. matsumotoi* for MATSUMOTO's species because it is preoccupied by HOFFET's. SUZUKI (1940) instituted a new genus, *Hoffetrigonia* and placed HOFFET's four species in it. In addition, *T. kodairai paucisulcatus* was described by SUZUKI from the lower Siragi series.

5. KOBAYASHI and SUZUKI (1941) described *T. kodairai* from the Lower Cretaceous Talatzu series.

6. SUZUKI (1943) restudied the Naktong fauna with his new collections. The detailed features of the pseudocardinal teeth of *Trigonioides* were unknown at that time, but *T. kodairai* from the upper Naktong shows the hinge feature clearly. He said that its hinge features are identical with those of *T. kodairai paucisulcatus* from the Siragi series and agree with the essential features with those of *T. matsumotoi*, and its ornament is intermediate between the typical form and *paucisulcatus*.

7. L. R. COX (1955) identified an internal mould from the lower Wakino subgroup with *T. kodairai*. Because its hinge structure and characteristic ornaments are so common in the typical unionids, i. e. *Castalia* and *Nippononaia*, he withdrew new family, Trigonioididae which he had proposed in 1952.

8. KOBAYASHI (1956) redescribed the dentition of *Trigonioides* and clarified its distinction from that of the unionid. Thus the Trigonioididae were revived as a solid family. However, he opined *Hoffetrigonia* to be a synonym of *Trigonioides*.

III On the classification of *Trigonioides*

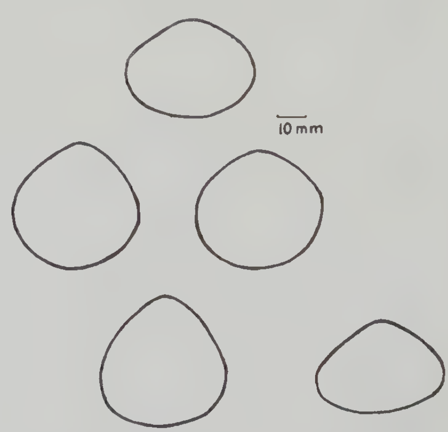
Trigonioides has been classified as follows:

1) Subtrapezoidal in outline, and sculpture found all over the surface .... *T. kodairai*
2) Rounded in outline, and sculpture remaining only in umbonal and posterior parts. . *T. kodairai paucisulcatus*
3) Rounded in outline, and similar to *T. kodairai* sculpture. . *T. matsumotoi*
4) Trigonal but more rounded than *T. kodairai*, and similar to *T. kodairai* sculpture .... *T. laotiae*
5) Trigonal and inequilateral.......... .... *T. kobayashi*
6) Trigonal and equilateral. . *T. trigonus*
7) Elliptical and sculpture different from the precedings in a few diagonal plications in front of umbonal angulation .... *T. diversicostatus*

In this classification, the outline and sculpture are seriously taken for the specific distinction. If one examines many specimens from a horizon, however, wide variation can be seen in outline and even in ornamention. Therefore, the above classification can not always be applicable to *Trigonioides*.

A) Shell-outline

a. It has been said that *matsumotoi* is distinct from *kodairai* in the more rounded outline. But it was found that

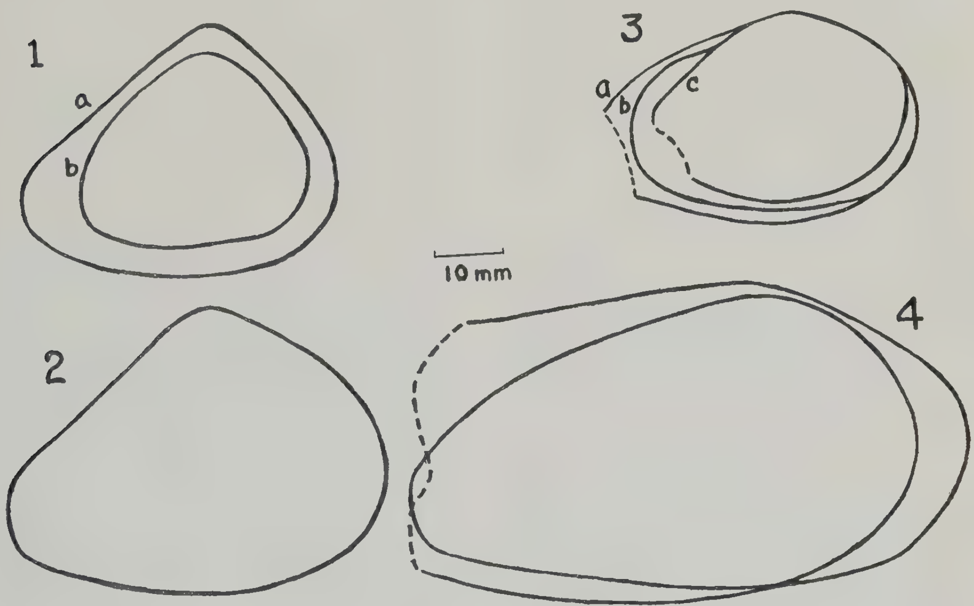


Text-figure 1. Variation of shell-outlines of *T. matsumotoi*, showing subelliptical, subtrigonal and intergradational forms.

several elongated specimens of the former species can not be distinguished from *kodairai* in outline.

b. The outline of *matsumotoi* from the same horizon is fairly variable as shown in Text-fig. 1. Their outlines are linked from subtrigonal to subelliptical by intermediate forms.

c. The writer has examined only a few Laos specimens. HOFFET's report does not give the frequency of occurrence. Text-fig. 2 was prepared from his Plates I, II and III to show variations in shell-outline. As shown in 3a and 3b of *laotiae*, they agree with *kodairai* in subelliptical outline. *Kobayashi* (2) also agrees with the holotype (1a) of *trigonus* in outline. Therefore, it is difficult to distinguish *kobayashi* from *trigonus* by the outline. Subtrigonal and subelliptical forms predominate in the Laos specimens, but there may be variation to some extent.



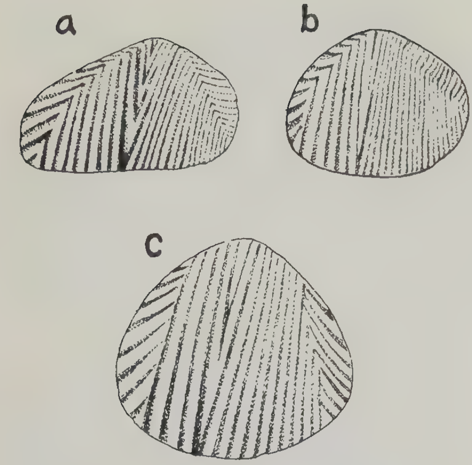
Text-figure 2. The variation of shell-outlines of Laos specimens after HOFFET (1937) Plates I, II and III.

1. a. b. *T. trigonus* HOFFET, a is the outline of the holotype.
2. *T. kobayashi* HOFFET.
3. a. b. c. *T. laotiae* HOFFET.
4. a. b. *T. diversicostatus* HOFFET.

B) Surface ornamentation

Whether *kodairai* type ornament covers all the surface or not has been noted, but there is tolerable variation. As shown in Text-fig. 3, the ornaments are classified into three types where *suzukii* type (b) of the upper Naktong and Wakino series is intermediate between *kodairai* type ornament (a) of the lower Naktong series and *matsumotoi* type (c) of the Gosyonoura.

The ornament of the Laos specimens indicates the last stage. Namely, *kobayashi* and *laotiae* are similar to *kodairai*



Text-figure 3. The typical ornaments of *Trigonioides*.
a. *Kodairai* type ornament.
b. *Suzukii* type ornament.
c. *Matsumotoi* type ornament.

type, but they lack reversed V-shaped ribs in anterior. In *trigonus* radial and concentric costae become nodose near their intersections. *Diversicostatus* has extraordinarily developed irregular ribs in the posterior.

IV New classification of *Trigonioides*

This genus which has constantly characteristic hinge teeth is classifiable by ornament as follows:

1) *Kodairai* type ....*T. kodairai*
2) *Suzukii* type ....*T. paucisulcatus suzukii* n. subsp.
3) *Paucisulcatus* type.................. ...... *T. paucisulcatus paucisulcatus*
4) *Matsumotoi* type......*T. matsumotoi*
5) With nodes at intersection of radial and concentric costae....*T. trigonus*
6) *Kodairai* type but lacking them in anterior....*T. kobayashi* (=*T. laotiae*)
7) Extraordinarily developed irregular ribs in posterior....*T. diversicostatus*

V Systematic description of *Trigonioides* in the Wakino and Gosyonoura formations.

A. Wakino group

The Wakino subgroup in N. Kyusyu was subdivided by the writer into the following formations in descending order:

Shimonoseki subgroup
———disconformity———
4. Upper Wakamiya formation
3. Lower Wakamiya formation
2. Nyoraida formation
1. Sengoku formation

(4.–1.: Wakino subgroup)
———clino-unconformity———
Paleozoic Aida group

T. paucisulcatus suzukii occurs with *Plicatounio naktongensis multiplicatus, Brotiopsis kobayashii* and *Viviparus* sp. at Hata, Yahata-city. This *suzukii* bed belongs to the upper formation as confirmed by the stratigraphy and paleontology of *Plicatounio*. It is noted that conjoined valves predominate and the arrangement of *Brotiopsis* is irregular in the upper formation.

Family **Trigonioididae** Cox, 1952

Genus *Trigonioides* KOBAYASHI and SUZUKI

1936. *Trigonioides* KOBAYASHI and SUZUKI, *Japan. Jour. Geol. Geogr., Vol. 13*, p. 248.
1937. *Trigonioides*, HOFFET, *Bull. du Serv. géol. de l'Indochine, Vol. 24*, p. 8.
1938. *Trigonioides*, MATSUMOTO, *Jour. Geol. Soc. Japan, Vol. 45*, p. 15.
1940. *Trigonioides*, SUZUKI, *Japan. Jour. Geol. Geogr., Vol. 17*, p. 228.

1941. *Trigonioides*, Kobayashi and Suzuki, *Bull. Geol. Inst. Manchoukuo, No. 101*, p. 78.
1955. *Trigonioides*, Cox, *Geol. Mag., Vol. 92*, p. 348.
1956. *Trigonioides*, Kobayashi, *Japan. Jour. Geol. Geogr., Vol. 27*, pp. 80–91.

Most distinguishing characteristics of this genus are in the surface ornamentation and hinge nature. The surface is usually marked with V-shaped ribs on the line across the umbo. Posterior ribs are generally thicker than anterior chevron ribs. Among the former there are extraordinarily stout ones. The ornaments in anterior and posterior areas are fairly variable among species. The hinge teeth consist of regularly crenulated pseudocardinal teeth and posterolateral teeth.

Trigonioides differs from those of Trigoniidae and Unionidae in the hinge nature. In the lack of a bifid median cardinal in the left valve, this differs from Trigoniidae. Supposing that the lateral tooth of Trigoniidae has been atrophied, however, the dentition of *T. matsumotoi* becomes similar to that of *Scabrotrigonia*. On the contrary, Cox emphasized that the dentition of *Trigonioides* is similar to that of *Castalia*. However, as Kobayashi pointed out already, *Castalia* has unionid feature in the irregularity of arrangement and crenulation. This is also similar to the hinge of *Nippononaia*, but differs in the composition and arrangement of teeth. The divergence of pseudocardinal teeth in *Quadrula* and *Plagiolopsis* seems also similar to that of *Trigonioides* but the former two are entirely different from the latter.

The opinion on the taxonomic position of *Trigonioides* does not agree between Cox (1955) and Kobayashi (1956). Kobayashi stated that the hinge of *Trigonioides* is more similar to trigonid than to unioid, while Cox referred it to the Unionidae, paying attention to the persistent hinge in numerous trigonids. In agreement with Kobayashi (1956) the writer claims that *Trigonioides* must belong to the family Trigonioididae by its hinge nature.

Hoffetrigonia was erected as a new genus by Suzuki (1940) by the reason that their outline and median tooth in the Laos specimens differ from those of the Japanese and Korean specimens. However, Kobayashi (1956) proved *Hoffetrigonia* to be synonymous with *Trigonioides* by the reason that they are not distinct in the outline and hinge nature. *Matsumotoi* and *paucisulcatus* are identical with the Laos specimens in the hinge nature. Therefore Kobayashi's opinion is correct.

Trigonioides paucisulcatus
Suzuki, 1940, (emend)

1940. *Trigonioides kodairai paucisulcatus* Suzuki, *Japan. Jour. Geol. Geogr., Vol. 17*, p. 229.

Description:—Shell medium, subtrigonal, transversely ovate in outline and subelliptical. Ligament external; pedal scar under strongest tooth (2a or 3a) in each valve fairly pronounced. Ornament of median area typical of the genus, but anterior and posterior ones are intermediate between *kodairai* and *matsumotoi*. Hinge well developed, characteristic of the genus:

$$\frac{5a \quad 3a \quad 1 \qquad\qquad 3b}{(4a) \quad 2a \quad 1'a \quad (1'b) \quad 2b \quad 4b}$$

where brackets indicate high variability, even the tooth being nullified. 4a low and weak, lower side only crenulated; 2a strongest, crenulated on both sides and oblique to hinge margin (ca. 60°); 1'b very small below the beak; 2b and 4b not protuberant as an independent

tooth but form a wall of a groove for 3b and they are fairly elongated but low, and each crenulated only on one side.

Comparison:—This species is fairly variable in outline and ornamentation. The Wakino specimens are, however, deformed. The ornament of *paucisulcatus suzukii* is intermediate between *kodairai* and *matsumotoi* (Text-fig. 3b). Its ornament somewhat varies in anterior. The ornament happens to disappear in the anterior and median area. The Siragi specimens are remarkably effaced. Originally SUZUKI (1940) described it as a subspecies (*kodairai paucisulcatus*), but the writer considers that it is better to be distinguished from *kodairai* as an independent.

Trigonioides paucisulcatus suzukii OTA, new subspecies

Plate 11, Figures 12-20.

Description:—Shell medium in size, subtrigonal or subelliptical in outline; ribs 3 or 5 in number in umbonal and median area, forming fine elongated Vs pointed ventrally. Ribs about 18 in anterior area, in reversed Vs appear from umbo; their angle more than twice (120°–130°) as large as posterior ones (ca. 60°); anterior ribs generally narrower than posterior ones; posterior ornaments vary fairly extensively, but generally consist of about 11 reversed V-ribs.

Observation:—Reversed Vs tend to become obsolete from median to anterior margin, while concentric costae appear strong as they procede to ventral margin or the reversed V-ribs have a tendency to become more or less zig-zag ribs in anterior. Another set of irregular ribs in posterior are sometimes branching toward ventral margin.

Comparison:—This subspecies is similar to *Nippononaia ryosekiana* SUZUKI in ornamentation but differs from the latter in the hinge and anterior and posterior ornaments. *T. matsumotoi* resembles this species in the hinge, but they disagree in posterior ornament.

Occurrence:—Lower part of upper Wakino formation at Hata, Katsuki-machi, Yahata-city, Fukuoka Pref.

B. Gosyonoura group

According to MATSUMOTO (1938), Gosyonoura Island consists mainly of the Gosyonoura group and partly of the Himenoura group, and the Gosyonoura is Gyliakian in age. *T. matsumotoi* is generally found as conjoined valves and they are irregularly disposed in the fossil bed (ca. 0.5 m thickness) of the coarse sandstone. This occurrence is negative for long transportation. This fossil bed contains no marine fossil but *Viviparus* (?) sp. is rarely found in it.

Trigonioides matsumotoi KOBAYASHI and SUZUKI, 1940

Plate 10, Figures. 1-15.

1938. *Trigonioides kobayashii* MATSUMOTO, *Jour. Geol. Soc. Japan, Vol. 45*, p. 14, Pl. 2, fig. 2.
1940. *Trigonioides matsumotoi* KOBAYASHI and SUZUKI, *Bull. Geol. Inst. Manchoukuo. No. 101*, p. 78.

Description:—Shell medium, ovately subelliptical, regularly rounded in lateral margins. Surface marked by radial ribs, every two of which meet together, forming an acute V on the line through umbo; a set of simple ribs composed of about 8 on anterior and 3 on posterior; another set of ribs branching off toward antero- and postero-dorsal margins from obtuse umbonal ridge; some of them yielding a few regular Vs in adult stage.

Hinge teeth well developed:

(5a) 3a 1a (1b) 3b
(4a) 2a 1′a (1′b) 2b 4b

where brackets indicate high variability. 4a along hinge margin degenerating; some fairly strong and crenulated on both sides, but most of them are weak or undeveloped. 2a strongest, crenulated on both sides, and oblique to hinge margin (ca. 30°), 1′a next strongest, crenulated on both sides, and oblique to hinge margin (ca. 60°); 1′b fairly developed or undeveloped; even when developed, it is small, crenulated on both sides, and half as long as 2a; when not so much developed, it has small node-like denticles in two rows; 2b and 4b rather degenerating, small and crenulated only on one side, even when developed.

Measurement:		Length	Height
Gu. K	1500	44 mm	38 mm
,,	1502	34 ,,	31 ,,
,,	1501	38 ,,	38 ,,
,,	1516	42 ,,	34 ,,
,,	1503	19 ,,	19 ,,
,,	1504	22 ,,	17 ,,

Comparison:—This species is similar to *paucisulcatus suzukii* but differs in anterior and posterior ornaments. It resembles *Nippononaia asinaria* REESIDE (1957) in the ornament, but they can be distinguished by the hinge nature.

Occurrence:—Upper Gosyonoura group at Kyodomari, Gosyonoura Island, Kumamoto Pref.

Trigonioides paucisulcatus paucisulcatus SUZUKI, 1940

Plate 10, Figure 16.

1940. *Trigonioides kodairai paucisulcatus* SUZUKI, *Japan. Jour. Geol. Geogr., Vol. 17*, p. 228, Pl. 24, Figs. 1-4.

Description:—Shell medium, transversely ovate and subelliptical in outline. Beak submedian, fairly large, prosogyrous, more or less incurved. Hinge teeth characteristic of the genus. Surface with *suzukii* type of ornament in umbonal and posterior areas, which disappears in anterior and median areas; concentric costae strong near ventral margin.

Comparison:—This differs from *kodairai, paucisulcatus suzukii* and *matsumotoi* in ornamentation. The ornament is effaced in various degrees.

Occurrence:—Rarely occurs with *matsumotoi* in upper Gosyonoura group at Kyodomari, Gosyonoura Island, Kumamoto Pref.

VI Phylogeny

The development of the hinge and ornaments is brought together with stratigraphical evidence into consideration.

A) Hinge nature

The hinge of *Trigonioiades* is fairly constant, although there are some variations in the median and lateral teeth. Generally, the lateral teeth indicate the degenerative features.

1) On the variation of the hinge teeth of the right valve.

a) In *suzukii*, 1b is not yet developed but the median tooth is simple.

b) In *matsumotoi*, 1b indicates the primitive feature of development. Namely, among the specimens, 1b is un-developed or a small independent tooth.

c) 1b is more developed in the Laos specimens than in *matsumotoi*, but it seems to have some variation in HOFFET's figures. 5a is a fairly constant tooth

but its development is fairly variable. 3a and 1a are constant teeth.

(2) On the variation of the hinge teeth of the left valve.

a) In *suzukii*, 1′b becomes an independent tooth. Namely, all *suzukii* specimens have it as a tooth but its development is fairly variable.

b) 1′b of *matsumotoi* and Laos specimens is same as that of *suzukii* but the development is fairly variable.

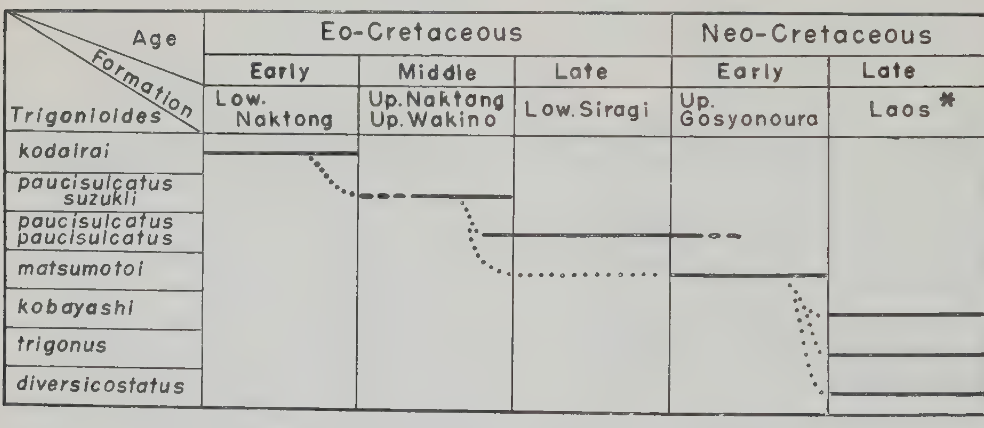
c) 4a is rather degenerating. Namely, 4a of *suzukii* appears as a small tooth along the hinge margin, but in the Laos specimens, 4a is undeveloped and two rows of small holes are seen on the hinge plate. 2b and 4b tend to degenerate. 2a and 1′a are constant teeth.

B) Ornamentation

As illustrated already, the ornaments of *Trigonioides* can be divided into a) *kodairai* type, c) *matsumotoi* type, and b) *suzukii* type which is intermediate between the two others. When one takes note on ontogeny, each type is a continuous series by the intermediate form. *Paucisulcatus paucisulcatus* is specialized from *suzukii* type. The upper Naktong subspecies indicaets an intermediate form between *paucisulcatus suzukii* and *paucisulcatus paucisulcatus*. Its ornament disappears from anterior to median in various degrees. Some specimens of *matsumotoi* type indicate also a similar feature to *kodairai* type even in the adult stage. As already illustrated, the Laos specimens indicate the ornament of the last stage which is fairly different from the above three types (a, b and c). However, their umbonal ornament is rather similar to *kodairai* type.

The above facts on phylogeny may be explained in the manner as shown in the table (p. 60).

Table showing the phylogeny of the *Trigonioides*.



* Terrain rouge crétacé de Muong-Phalane.

Trans. Proc. Palaeont. Soc. Japan, N. S., No. 34, pp. 105-110, pls. 10, 11, June 15, 1959

364. ON THE "*NIPPONONAIA*" FROM THE LOWER CRETACEOUS WAKINO SUBGROUP, NORTH KYUSYU, JAPAN.

(Studies on the Molluscan Fauna of the Cretaceous Inkstone Series. Part 3.)*

YOSHIHISA OTA

Fukuoka Liberal Arts College.

下部白亜系脇野亜層群産 "*Nippononaia*" について： L. R. Cox 博士と小林教授との論争に関係する脇野下部層のものは，ornament, outline, hinge 等で *Nippononaia* に似ている．然し hinge, ornament で相異もあり *Nippononaia* の diagnosis と完全には一致しない．*Nippononaia* の模式標本は出所不明で然も戦火で焼失している．従つて取扱に種々の難点があるが今回は "*Nippononaia*" として取扱い，脇野下部層から 2 新種を記載した．又 ornament で非常によく似る *Trigonioides* との相異点を明らかにした．

太 田 喜 久

In 1941, SUZUKI erected a subgenus, *Nippononaia*, with an internal and external moulds. However, whether the specimens came from the Lower Cretaceous of Sanchu graben in Kwanto mountains or Katsuragawa basin in eastern Shikoku was a quesion. They were unfortunately gone by a fire in the Second Great War.

Lately I collected several specimens from the Lower Cretaceous Wakino subgroup. They are similar to *Trigonioides kodairai* KOBAYASHI and SUZUKI in the ornament and *Plicatounio kwanmonensis* OTA in the hinge nature. Namely, they have intermediate features between *Trigonioides* and *Plicatounio* but probably more related to *Nippononaia ryosěkiana* SUZUKI in both respects. When the hinge is unknown, one can not distinguish them from *T. kodairai*. Therefore these Wakino specimens have once been taken for *T. kodairai* but its type locality is the lower Naktong formation at Shinshu, Korea. The specimen (COX, 1955. Text fig. A; KOBAYASHI, 1956. Pl. V. Fig. 3; OTA, Pl. 6, Fig. 11) which was disputed by COX and KOBAYASHI was an internal mould collected by me from the lower Wakino formation. COX referred it to *T. kodairai*, and KOBAYASHI to *Plicatounio naktongensis multiplicatus*, if not a *Nippononaia*. It is difficult to decide whether the specimen belongs to "*Nippononaia*" or *Plicatounio*, for its surface ornament can not be seen. I have once identified it with *T. kodairai*, but now it is ascertained that the Wakino specimens can be distinguished from *Trigonioides* in the hinge nature.

I want to describe here two new species from the lower Wakino formation, which are provisionally referred to "*Nippononaia*", although much obscurity is attached to the hinge nature of true *Nippononaia* and its taxonomic position is ambiguous.

Before going further, I wish to record his warmest appreciations to Prof. T. KOBAYASHI of the University

* Received July 26, 1958; red Feb. 14, 1959 at Hiroshima University.

of Tokyo, for his continuous encouragement, and express many thanks to Messrs I. HAYAMI and A. TOKUYAMA of the University and Mr. M. NAKANO of the Hiroshima University and Assist. Prof. H. HONTO of the Fukuoka Liberal Arts College at Tagawa for their kind help.

I Distinction among "*Nippononaia*", *Trigonioides* and *Plicatounio*.

A. The difference of "*Nippononaia*" from *Trigonioides* on one side, from *Plicatounio* on the other. One can easily distinguish the last from the two others in outline and ornament. Namely, *Plicatounio* is distinct from them in its posterior radial plications and transversely elongated outline. *Plicatounio* is more or less similar to "*Nippononaia*" in the subquadrate or subtriangular outline.

B. It is not always easy to distinguish "*Nippononaia*" from *Trigonioides* as they resemble in the outlines and ornaments. As the result of this study, it was found that the two genera can be distinguished by the hinge nature. More precisely, the median teeth are more developed in *Trigonioides* than in "*Nippononaia*", as formulated below:

"*Nippononaia*"

5a 3a (3b) 5b
(4a) 2a (1′) 2b 4b

Trigonioides

(5a) 3a 1a (1b) 3b
(4a) 2a 1′a (1′b) 2b 4b

where brackets indicate such great variability that the teeth in brackets are sometimes totally absent. Furthermore, the difference between them exists in the disposition of hinge teeth. Two pseudocardinal teeth are subparallel to the anterior hinge margin in the left valve of "*Nippononaia*", while in that of *Trigonioides* they are four in number, diverging from beak to the anterior hinge margin with angles of 0°, 30°, 60° and 90° (Text-fig. A).

The hinge plate of "*Nippononaia*" is narrow with slender teeth and that of *Trigonioides* wide with stout dentition.

SUZUKI in his second paper (1943) took true *Nippononaia* as a subgenus of *Plicatounio* instead of *Unio* because of its hinge nature indistinguishable from that of *Plicatounio*. "*Nippononaia*" is somewhat similar to *P. kwanmonensis* OTA (1958) in the hinge but fairly different from *P. naktongensis* which has many unionid features in the hinge nature.

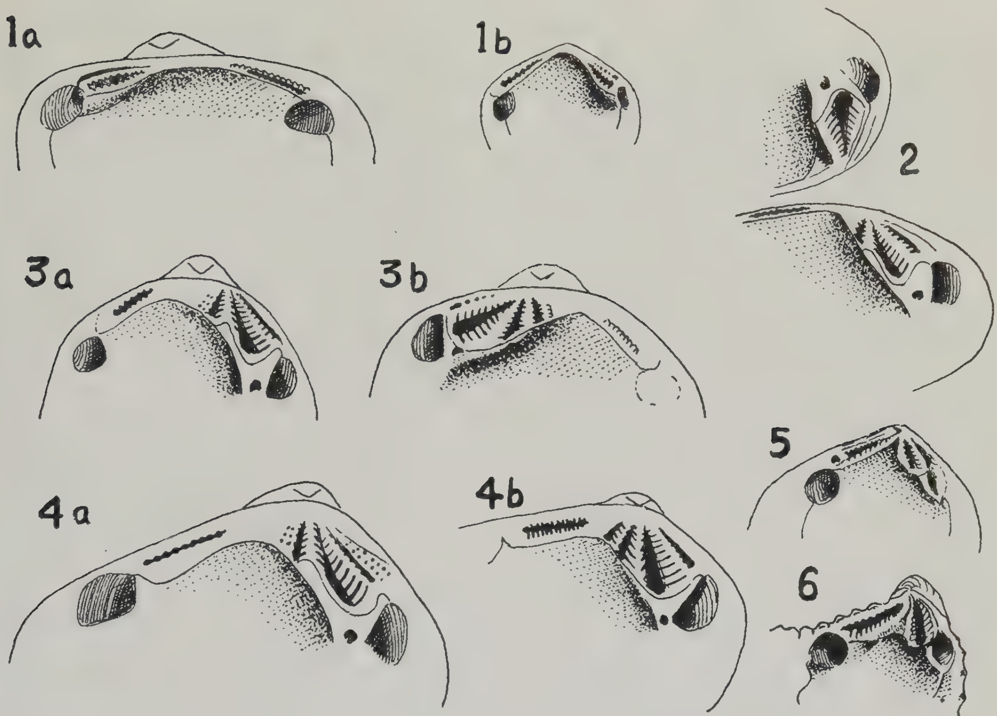
II Comparison between American species of *Nippononaia* and "*Nippononaia*" of the Wakino subgroup.

REESIDE (1957) reported the find of *Nippononaia* in the Lower Cretaceous of Colorado, North America. Comparing "*Nippononaia*" of Wakino with REESIDE's, the following differences can hardly be overlooked.

1) In the composition and arrangement of the teeth, they are very much alike, but REESIDE's teeth are not distinctly crenulated as those of Wakino form.

2) REESIDE's appears rather smooth according to his Text-figure 2 (REESIDE, 1957. p. 652), but the Wakino form has distinct crenulation on the ventral margin. However, I can not make sure whether the ventral margin of REESIDE's is crenulated or smooth as nothing is stated.

3) In ornamentation REESIDE's is more similar to *Trigonioides matsumotoi* KOBAYASHI and SUZUKI than *Nippononaia*



Text-figure. A. Hinge-structure of " *Nippononaia* ", *Trigonioides* and *Trigonia*.

1 a. " *Nippononaia* " *wakinoensis* (?) OTA, n. sp.

1 b. " *Nippononaia* " *sengokuensis* OTA, n. sp.

Lower Wakino subgroup, N. Kyusyu, Japan (based on an artificial cast made from a natural mould.)

2. *Trigonioides paucisulcatus suzukii* OTA n. subsp.

Upper Wakino subgroup, N. Kyusyu, Japan (based on an artificial cast made fromea natural mould.)

3 a. and 3 b. *Trigonioides matsumotoi* KOBAYASHI and SUZUKI

Upper Gosyonoura group, Amakusa, Japan (based on an artificial cast made from a natural mould.)

4 a. *Trigonioides kobayashi* HOFFET

Senonian Bas Laos (based on a left valve)

4 b. Based on HOFFET (1937) Text-fig. (P. 10, fig. 3)

5. *Neotrigonia margaritacea* LAMARCK

6. *Scabrotrigonia scabra* (LAMARCK)

Based on the Text-figs. 20 and 22 (p. 25) published by LEBKÜCHNER (1932).

ryosekiana and Wakino form.

As the difference between REESIDE's form and Wakino one is distinct, I consider at present that the former should be excluded from " *Nippononaia* " in my mind.

III Description of Species.

Genus " *Nippononaia* " SUZUKI, 1941

" *Nippononaia* " *wakinoensis* OTA, new species

Plate 11, Figures 1-7, 11.

Description:—Shell medium in size, transversely elongated, subelliptical in outline, subequilateral, regularly rounded in anterior and subquadrate in posterior; dorsal margin broadly arched, subparallel to ventral margin which is slightly curved. Test fairly thick. Beak fairly prominent, prosogyrous, more or less incurved, placed at about two-fifths to submedian and fairly projected above hinge line. Surface ornamented with many V-shaped ribs crossed by concentric growth lines; radial ribs fine and closely set in middle; several middle ribs (6–8) converging to form acute Vs on a line through beak; each side of them regularly ornamented with reversed V-ribs; anterior ribs about 18–20 including middle V-ribs smaller and more numerous than posterior (14–16). Hinge well developed; cardinal teeth relatively short, narrow and finely crenulated; lower one stronger than upper; lateral teeth fairly long, lamellar, finely crenulated, but weak and lower than anterior ones. Internally, ventral margin crenulated especially in posterior half.

Measurements:		Length	Height
Wl. S	5057	31 mm	26 mm
,,	5060	48	31
,,	5051	47-	24
,,	5086	42	20

Occurrence:—Lower Sengoku formation in Wakino subgroup at Rikimaru, Miyatamachi, Kurate-gun, Fukuoka Pref.

Observation:—The hinge nature and surface ornament vary considerably; 4a, 3b and median tooth are developed in some but not in others. Namely, 4a and 3b are degenerative. Even when developed, they are smaller than the others and a little convex and crenulated only on one side. It is a tendency for 3a or 2a to branch off near beak. The branching tooth can be seen as arrangements of nodes under the beak.

The ornament of the anterior area is variable. Namely, anterior ribs become weak in adult stages, while radial ones are sometimes replaced by concentric costae. In the anterior area ribs are sometimes zig-zag or irregular.

Comparison:—This is most similar to *N. ryosekiana* SUZUKI in outline, ornamentation and hinge nature.* However, "*N.*" *wakinoensis* differs from *N. ryosekiana* in lateral teeth and posterior ornament. This new species is also similar to *Trigonioides kodairai* and *T. paucisulcatus suzukii*, but differs in the hinge nature. As already discussed, this differs from *N. asinaria* REESIDE in hinge and ornament.

Occurrence:—Lower Wakino formation at Rikimaru, Miyata-machi, Kurate-gun, Fukuoka Pref.

"*Nippononaia*" *sengokuensis* OTA, new species

Plate 11, Figures 8–10.

Description:—Shell rather small, oboval, moderately convex, subequilateral, rather regularly rounded on both sides, ventral margin rounded. Beak small, submedian, prosogyrous, more or less incurved. Numerous ribs arranged as usual in *wakinoensis*. Hinge teeth identical with those of the species, but the angle of hinge margin is smaller.

* I showed these specimens of "*N.*" *wakinoensis* to Dr. K. SUZUKI who erected *Nippononaia*. He said that the Wakino specimens are so similar to *N. ryosekiana* in all respects that they are referable to his subgenus, notwithstanding the fact that the two species disagree in the number and crenulation of lateral teeth.

Measurements:		Length	Height
Wl. S	5053	19 mm	17 mm
"	5050	22	21
"	5031	18	17

Comparison:—This is distinguished from "*N.*" *wakinoensis* and "*N.*" *ryosekiana* SUZUKI by small size and oboval outline of the shell. *T. kodairai* was originally described from lower Naktong and Wakino series by KOBAYASHI and SUZUKI. The Wakino specimen (KOBAYASHI and SUZUKI, 1936. Pl. 29, Fig. 13) which they described is incomplete in ornament, and its hinge nature is also not distinct. Therefore I cannot accurately determine whether it is *T. kodairai* or "*N.*" *sengokuensis*. But I presume that it is probably "*N.*" *sengokuensis* as suggested by its oboval outline and small size.

Occurrence:—Same as the preceding species.

References

COX, L. R. (1954), Notes on the Trigoniidae, with Outlines of a Classification of the Family. *Proc. Mal. Soc. London, vol. 29, Pts. 2 & 3.*

—— (1955), On the Affinity of *Trigonioides* and *Hoffetrigonia*. *Geol. Mag., Vol. 92.*

CONRAD, A. (1853), Synopsis of the Family Naiades, *Proc. Acad. Nat. Sci. Philadelphia, Vol. 6.*

DAVIES, A. M. (1953), Tertiary Faunas, vol. 1, *London.*

HOFFET, J. H. (1937a), Sur le Genre *Trigonioides*, Mutation génétique stable du Genre *Trigonia*. *C. R. des seances de l'Acad. des Sci, Paris*, 1937.

—— (1937b), Les Lamellibranchis saumatres du Muong Phalane (Bas Laos). *Bull. Šerv. Geol. l'Indochine, Vol. 24.*

KOBAYASHI, T and SUZUKI, K. (1936), Non-marine Shells of the Naktong-Wakino Series. *Japan. Jour. Geol. Geogr., Vol. 13.*

—— and —— (1941), On the Occurrence of *Trigonioides* in Southeastern Manchoukuo. *Bull. Geol. Inst. Manchoukuo, No. 101.*

KOBAYASHI, T. (1954), Studies on the Jurassic Trigonian in Japan, Pt. 1. Preliminary Notes. *Japan. Jour. Geol. Geogr., Vol. 25, Nos. 1-2.*

—— and MORI, K. (1955), The Vaugoniinae from the Kitakami Mountains in North Japan. On the Jurassic Trigonians in Japan, Pt. 3. *Ibid., Vol. 26, Nos. 1-2.*

KOBAYASHI, T. (1956), On the Dentition of *Trigonioides* and its Relation to Similar Pelecypod Genera. *Ibid., Vol. 27, No. 1.*

LEBKÜCHNER, R. (1932), Die Trigonien des Suddeütschen Jura. *Palaeotogr., Bd. 77.*

MATSUMOTO, T. (1938), Geology of the Gosyonoura Islands, Amakusa, with special Reference to the Cretaceous Stratigraphy. *Jour. Geol. Soc. Japan, Vol. 45.*

—— et al. (1954), The Cretaceous System in the Japanese Islands. *Japan. Soc. Promotion. Sci. Research, Tokyo.*

PRASHAD, B. (1919), Studies on the Anatomy of Indian Mollusca. No. 3. *Records Indian Mus., Vol. 16.*

REESIDE, J. B. (1957), Non-marine pelecypod (*Nippononaia asinaria*) from the Lower Cretaceous of Colorado. *Jour. Pal., Vol. 31, No. 3.*

SUZUKI, K. (1940), Non-marine Molluscan Faunule of the Siragi Series in South Tyosen. *Japan. Jour. Geol. Geogr., Vol. 17.*

—— (1941), A new naiad, *Unio* (*Nippononaia*) *ryosekiana*, n. subgen. and n. sp. from the Lower Cretaceous of Japan. *Jour. Geol. Soc. Japan, Vol. 48.*

—— (1943), Restudy on the Non-Marine Molluscan Fauna of the Rakuto Series in Keisho-do, Korea. *Jour. Shigen Kagaku Kenkyu-Sho, Vol. 1, No. 2.*

—— (1949), Developement of the Fossil Non-Marine Molluscan Faunas in Eastern Asia. *Japan. Jour. Geol. Geogr., Vol. 21.*

THIELE, J. (1934-35), Handbuch der systematischen Weichtierkunde. *Bd. 2, Jena.*

Explanation of Plate 10

All natural size

Trigonioides matsumotoi KOBAYASHI and SUZUKI ....Page 102

Fig. 1. Right internal mould, showing the hinge.

Figs. 2, 3, 4, 5, 6, and 7. Left internal moulds.

Figs. 8, 9, 10 and 11. Right internal moulds.

Fig. 12. Right external mould, showing the posterior and median ornament.

Fig. 13. Right plaster cast.

Fig. 14. Right external mould, showing an anterior and median ornament.

Fig. 15. Right artificial cast, showing the anterior ornament.

Trigonioides paucisulcatus paucisulcatus SUZUKI ....Page 103

Fig. 16. Incomplete right internal mould, showing the anterior ornament.

Upper Gosyonoura group at Kyodomari, Gosyonoura Island, Kumamoto Pref.

Explanation of Plate 11

All natural size except Eig. 9 (×2)

"*Nippononaia*" *wakinoensis* OTA, new species....................................page 107

Fig. 1. Right internal mould, holotype.

Figs. 2a and 2b. Plaster cast showing the surface ornament.

Figs. 3 and 4. Internal moulds of an immature right valves, showing the outline of the younger stage.

Fig. 5. Plaster cast of an incomplete right valve.

Fig. 6. Plaster cast of an incomplete left valve.

Fig. 7. External mould of a right valve, showing disappearance of the anterior radial ribs.

"*Nippononaia*" *sengokuensis* OTA, new species ....Page 108

Fig. 8. Left internal mould, holotype.

Fig. 9. Right internal mould.

Fig. 10. Plaster cast of an incomplete right valve.

"*Nippononaia*" *wakinoensis* OTA, (?)

Fig. 11. Right internal mould.

All above specimens: Lower Wakino subgroup at Rikimaru, Miyata-machi, Kurate-gun, Fukuoka Pref.

Trigonioides paucisulcatus suzukii OTA, new subspecies ....Page 102

Fig. 12. Internal mould of the bivalve, holotype, showing the hinge.

Fig. 13. External moulds of the paratype bivalve, showing the surface ornament.

Fig. 14. Right internal mould.

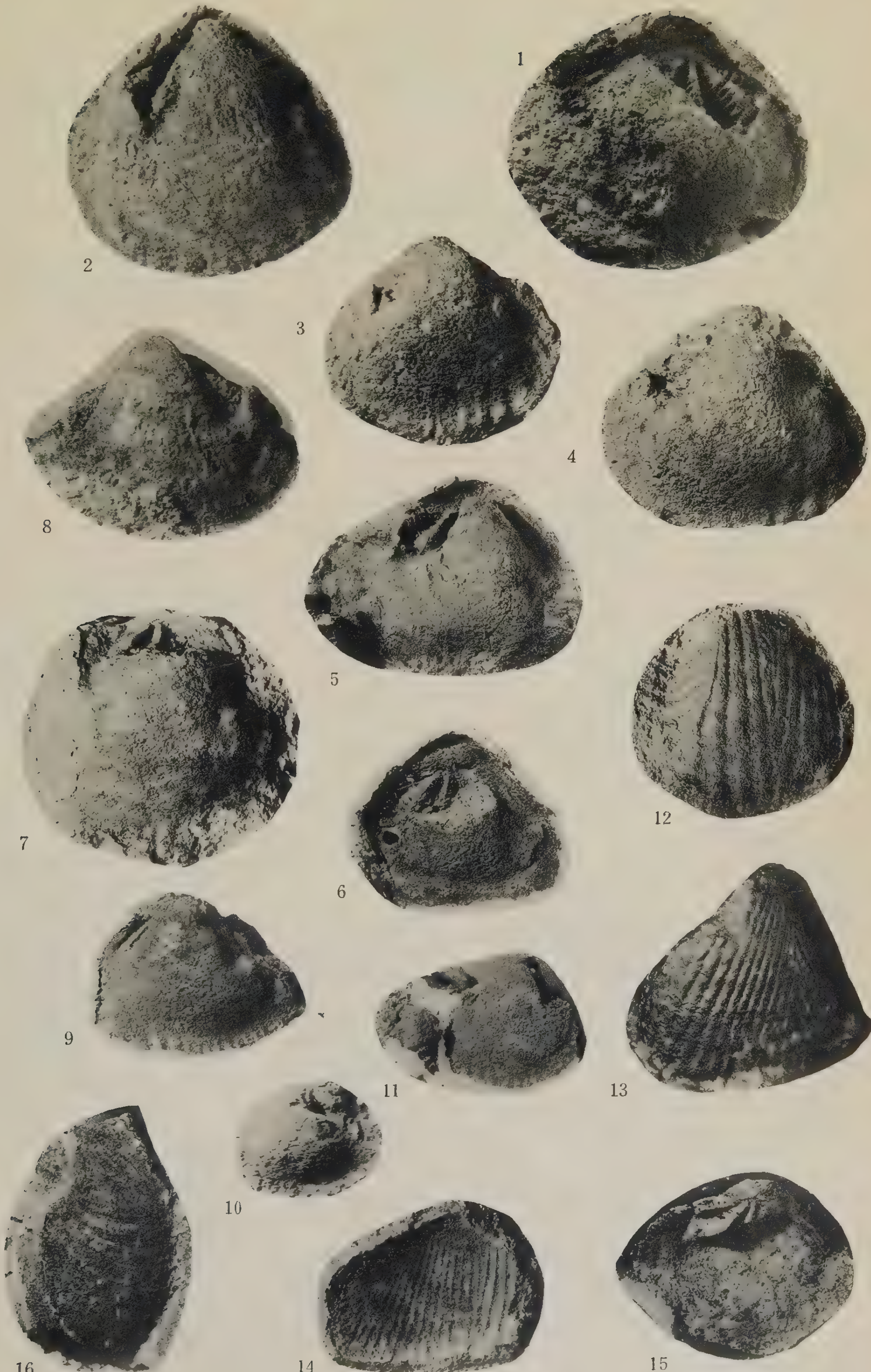
Figs. 15 and 16. Bivalve internal moulds, showing the hinge.

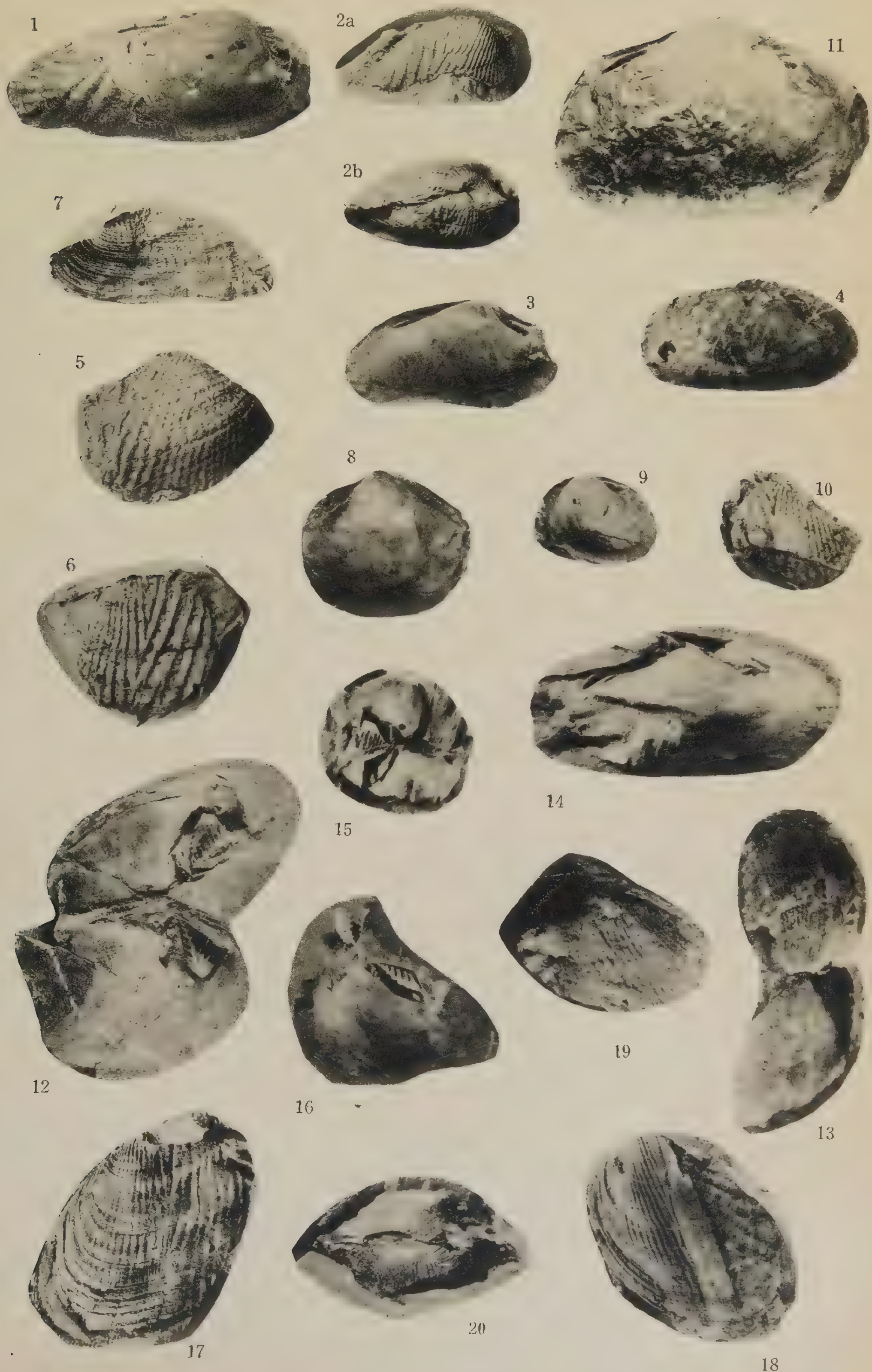
Figs. 17 and 18. Right external moulds.

Fig. 19. Left external mould.

Fig. 20. Dorsal view of an external mould of a bivalve.

Upper Wakino subgroup at Hata, Katsuki-machi, Yahata-city, Fukuoka Pref.


1
2
3
4
5
6
7
8
9
10
11
12
13
14
15
16


1
2a
11
2b
7
3
4
5
8
9
10
6
15
14
12
16
19
13
17
20
18

Trans. Proc. Palaeont. Soc. Japan, N. S., No. 34, p. 111, June 15, 1959

SHORT NOTES

4. *TRITICITES THALMANNI* SAKAGAMI AND OMATA AND *SCHWAGERINA GUEMBELI OMENSIS* SAKAGAMI AND OMATA, NEW NAME FOR *T. INTERMEDIA* AND *S. GUEMBELI COMPACTA*

SUMIO SAKAGAMI

Department of Geology, Hokkaido Gakugei University

and

TOSHIKAZU OMATA

Mizuho Middle School, Tokyo

Prof. Dr. H. E. THALMANN has kindly called attention to two homonyms in our paper (S. SAKAGAMI and T. OMATA, 1957, *Japan., Jour. Geol. Geogr., vol. XXVIII, no. 4*, pp. 247–264, pls. XIX-XX). Namely, 1) our new species *Triticites intermedia* on p. 253 is preoccupied by *Triticites jigulensis* RAUSER, 1938, var. *intermedia* SLYKOWA, 1948; and again by *T.* (*Jigulites*) *intermedius* ROZOVSKAJA, 1950; from the upper Carboniferous of USSR, and 2) our *Schwagerina guembeli compacta* n. subsp. on p. 258 is also preoccupied by *Schwagerina compacta* (WHITE, 1932) according to DUNBAR and SKINNER, 1937, *Univ. Texas Bull. 3701*, p. 645 (for *Triticites compactus* WHITE, 1932). Therefore, new names *Triticites thalmanni* SAKAGAMI and OMATA and *Schwagerina guembeli omensis* SAKAGAMI and OMATA are here proposed for the homonyms *T. intermedia* SAKAGAMI and OMATA and *S. guembeli compacta* SAKAGAMI and OMATA, respectively. Our thanks are extended to Prof. Dr. Hans E. THALMANN of Stanford University for having pointed out this error.

N E W S

◎ XXI Session, International Geological Congress と同時に開催される International Paleontological Union の会合では次のトピックについて討論が行なわれることになった。

A. Paleoecology: Methods and principles; examples of paleoecological syntheses.
B. Paleobotany: Calcareous algae, especially the Solenoporaceae. Stromatoliths.
C. Micropaleontology: Mesozoic and Cainozoic pelagic Formaminifera and their stratigraphical importance.
D. Invertebrate paleontology: Interpretation of primitive fossils and intermediate groups.
E. Vertebrate paleontology: The adaptation of vertebrates to terrestrial and aquatic environments; passage-forms.
F. Zoological nomenclature.
G. Other subjects: Communications of general interest. or contributing important new data.

Congress の詳細については 4 月 1 日発行の Second Circular を参照されたい。

◎ 1959 年 8 月 30 日より 9 月 12 日にわたり New York で開催される International Oceangraphic Congress で Paleobiogeography に関して次の panel discussions が行なわれることになった (* 印は現在までに出席の決定している者)

Panel I. (9 Sept.) Basis of paleobiogeography (KSIAZKIEWICZ, discussion leader)

* William S. von ARX—An experimental approach to paleooceanography (a talk will be presented and motion pictures will be shown)
* RICHARD R. DOELL—Paleomagnetism
E. MONTANARO-GALLITELLI—West Mediterranean marine paleobiogeography
R. Th. HECKER, A. I. OSSIPOVA, and T. N. BELSKAYA—Paleobiogeography of the Fergana Gulf in the Paleogene Sea
* John IMBRIE—Evolution of major adaptive invertebrate types
E. A. IVANOVA—Marine paleobiogeography of the Russian coal fields
Teiichi KOBAYASHI—Necroplankton and other dispersal artifacts
* Marian KSIAZKIEWICZ—Life conditions in flysch basins
G. U. LINDBERG—The discontinuous distribution of fishes and large fluctuations in ocean level
H. W. MENARD—Possible former isthmian links in the Pacific Ocean
* Siemon W. MULLER—Triassic and Early Jurassic paleobiogeography
J. M. PÉRÈS and J. PICARD—Origin, distribution, and recent alterations in the Mediterranean benthic fauna
* Curt TEICHERT—Evaluation of bathymetric evidence furnished by marine fossils
Karl TUREKIAN and Karl WAAGÉ—
James W. VALENTINE—Marine climatic record of Northwest American epicontinental Pleistocene
* W. P. WOODRING—Tertiary Caribbean molluscan faunal province

Panel II. (10 Sept.) Organic aspects of paleobiogeography as illustrated by distribution of reef-building organisms in time and space (LECOMPTE, discussion leader)

F. M. BAYER—
* Helen DUNCAN—Lower Paleozoic reefs
* A. G. FISCHER—Anthozoan growth patterns
T. F. GOREAU—Caribbean reefs
H. S. LADD—

* Marius LECOMPTE—Le phénomène récifal dans la partie europeene occidentale du géosynclinal hercynion
Heinz LOWENSTAMM—
* N. D. NEWELL—West Atlantic coral reefs
Ting Ying H. MA—History of the Pacific, Atlantic, and Indian ocean basins as deduced from growth values of reef corals
Daninele ROSSI—Italian Triassic reefs
* Eugen and Ilse SEIBOLD—Foraminifera and facies; examples from the sponge bioherms and bedded limestones in the lower Malm of south Germany
Henri and Genevieve TERMIER—Bioherms, limestones and carbonate rock building organisms
John W. WELLS—

Panel III. (11 Sept.) Major features of Cambro-Ordovician marine biogeography—a test of available methods (PALMER, discussion leader)
* Wm. B. N. BERRY—Distribution of Ordovician graptolites
Kenneth CASTER—
* Alan V. COX—Physical consequences of shifting poles or crust
* Rousseau FLOWER—Ordovician faunal realms
Zofia KIELAN-JAWAROSKA—Late Ordovician trilobite migrations
* A. R. PALMER—Early Uppər Cambrian biogeography
* Reuben J. ROSS, Jr.—Bighorn fauna
Nils SPJELNAES—Middle and Upper Ordovician faunal patterns
* H. B. WHITTINGTON—Ordovician trilobite distribution
Alwyn WILLIAMS—Ordovician brachiopod distribution

◎ International Organization of Paleobotany の会合は第 9 回 International Congress of Botany の会期中 1959 年 8 月 24 日に Canada の Montreal で開催されることになった。

◎ 第 10 回 Pacific Science Congress は Honolulu の Hawaii 大学で 1961 年 8 月 21 日より 9 月 2 日にわたって開催されることになった。

◎ 有孔虫研究連絡会（東北大学理学部地質学古生物学教室）発行の「有孔虫」第 10 号（1959 年 5 月）には「日本白亜・古第三系の境界問題」という特集が掲載されている。希望者は同会に申込まれたい。

日本古生物学会例会通知

	開催地	開催日	講演申込締切日
第74回 例会	京都大学	1959 年 10 月 18 日	1959 年 9 月 25 日

講読御希望の方は本会宛御申込下さい

1959 年 6 月 10 日 印刷
1959 年 6 月 15 日 発行

日本古生物学会報告・紀事
新篇 第 34 号
250 円

東京大学理学部地質学教室内
日本古生物学会
編集者 高井冬二
発行者 市川健雄
（振替口座東京 84780 番）
印刷者 東京都港区芝浦 1 丁目 1
株式会社 ヘラルド社 富田元

日本古生物学会報告紀事出版規定

（1959年12月6日改正）

I. 投 稿 規 定

1. 原稿は日本古生物学会の年会または例会において講演（代読を認める）したものに限る。
2. 原稿は欧文に限り，タイプライター用紙（22.5×27.5 cm）に1行おきに明瞭にタイプライトし，学名はイタリックに著者自身指定する。
3. 原稿（挿図・地図・付表を含む）は8印刷頁（タイプライター用紙約18枚）を限度とする。
4. 図版（14.2×20.0 cm）は1枚まで掲載出来る。
5. 挿図（6坪以下のもの2個・1坪は1寸平方）は白紙に墨または製図用黒インクにて明瞭に書き，図中の字はなるべく活字又はタイプライター字をはりつける。印刷に際して縮図することがあるから，線の太さ，字の大きさなどはこの点を充分に考えに入れて書く必要がある。
6. 地図には必ず縮尺をつける。縮尺何分の1としたものはいけない。
7. 以上の限度を超える場合は著者がその費用を負担する。
8. 原稿には邦文表題と簡単な邦文要約を付記する。
9. 引用文献はすべての文の最後に文献の項を設けてそこに一括する。文献は著者名のアルファベット順に配列し，同一著者の論文は発表年代順とする。著者名・発表年・論文表題・雑誌名・巻・頁・図版・挿図・地図・付表等を正確に記入する。
10. 原稿には著者名の次に現在の所属機関名を付記する。
11. 1印刷頁以内の短報（挿図・地図・付表を含む）は余白あり次第，受理日付の順に掲載する。
12. 別刷の必要部数を原稿に付記する。但し無表紙100部までは無償で，それ以上は著者がその費用を負担する。
13. 原稿は著者の責任において外人または適当と認められる人に見て貰う。

II. 編 集 規 定

1. 編集委員は原稿の受理・保管・編集を行う。
2. 編集委員は原稿を受理した場合，その原稿が鮮明であり且つ其の他形式上の不備の無いことを確認した上で直ちに受理日付を記入し，著者には保管証を送る。
3. 原稿の採用不採用は会長と常務委員との合議により決定する。
4. 編集委員は不採用原稿を不採用の理由を付記して著者に返却する。
5. 編集委員は採用原稿を出版費に応じて，受理日付の順に掲載する。
6. 著者が編集前に論文内容を訂正した場合には受理日付を変更する。
7. 印刷の体裁は大略 Journal of Paleontology の体裁に準ずる。
8. 校正は出版委員の責任においてこれを行う。